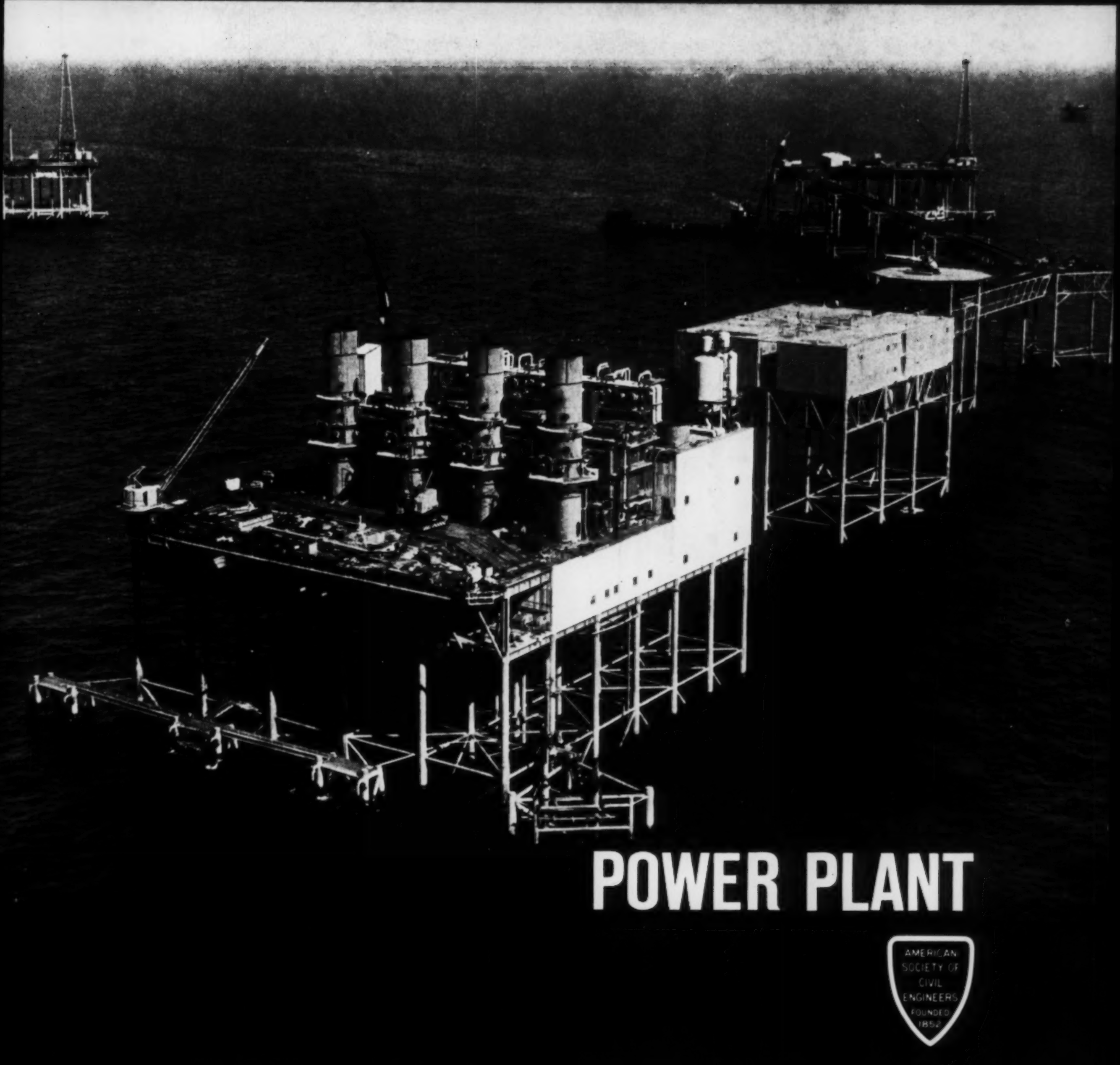
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION [illegible]



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FOUNDED 1852

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A structure of efficient, long lasting steel can fit the personality and requirements of the firm for which it is designed like the initials on the president's cuff links. You'll find no reluctance on the part of its designers to tailor a steel structure as imaginatively as a Paris couturier, while costs remain at bargain basement levels. And steel goes up fast too—saving valuable time. Bristol Steel is proud to be a partner with the nation's best architects and engineers in creating personalized structures. Bristol Steel will take a personal interest in your next structural job. An inquiry will get us started!

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AND IRON WORKS, INC.

BRISTOL VIRGINIA

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it pays to specify Vitrified Clay Pipe

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Like Santa Paula, growing communities everywhere need the permanence and safety that only Clay Pipe can provide. Clay Pipe is the only pipe that never wears out . . . does not rust, rot, corrode, or crumble. And with its new research-developed, factory-made joints, Clay Pipe is faster and easier to install than ever before.

When your community plans new sewerage facilities, be sure to consider the exceptional advantages of Clay Pipe. Its exclusive long-term guarantee is your assurance of permanent, maintenance-free service. Only Clay Pipe has *all* the features you can trust to handle industrial growth.

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CONSULTING ENGINEERS: J. M. Montgomery Engineering Co. **CONTRACTOR:** N. P. Van Valkenburgh Co.

C-199-2A

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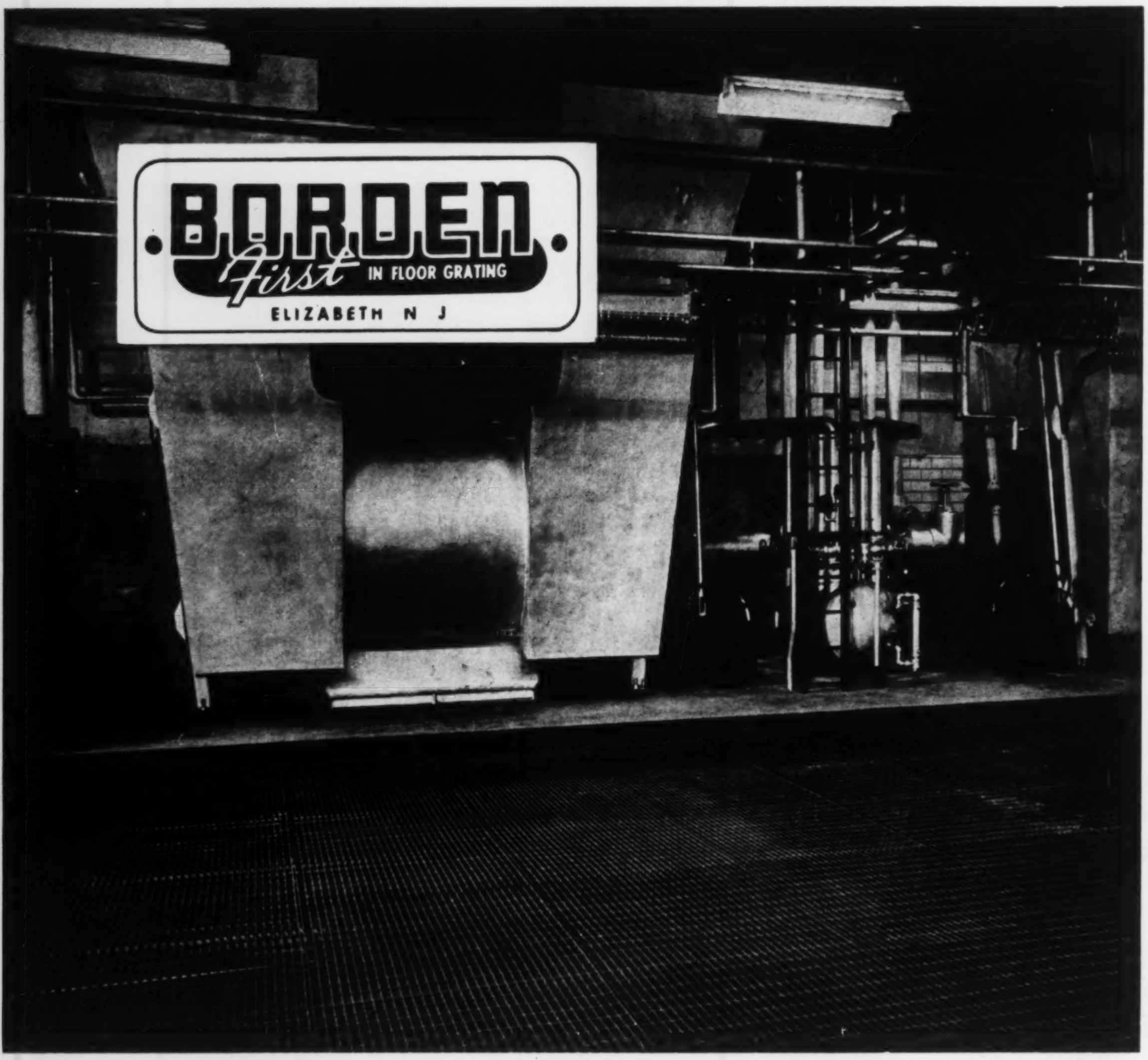

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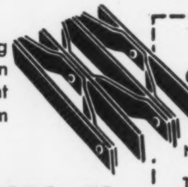

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JUNE 1960
VOL. 30 • NO. 6

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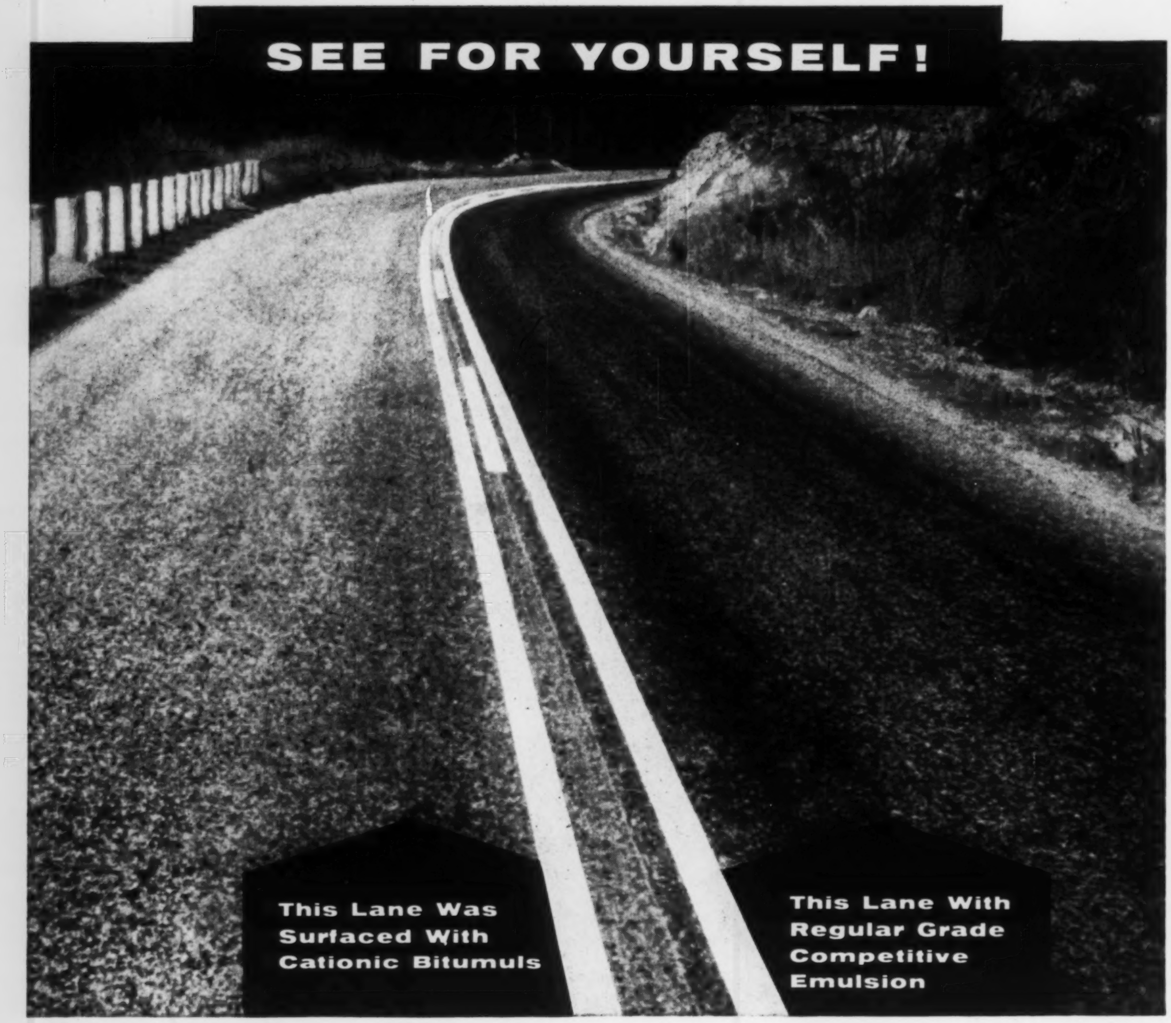
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This Lane With Regular Grade Competitive Emulsion

You Get BETTER Surface Treatments With CATIONIC BITUMULS

This photograph gives visible proof of the superior performance of Cationic Bitumuls. The picture was taken on a 25-mile test section of highway in North Carolina.

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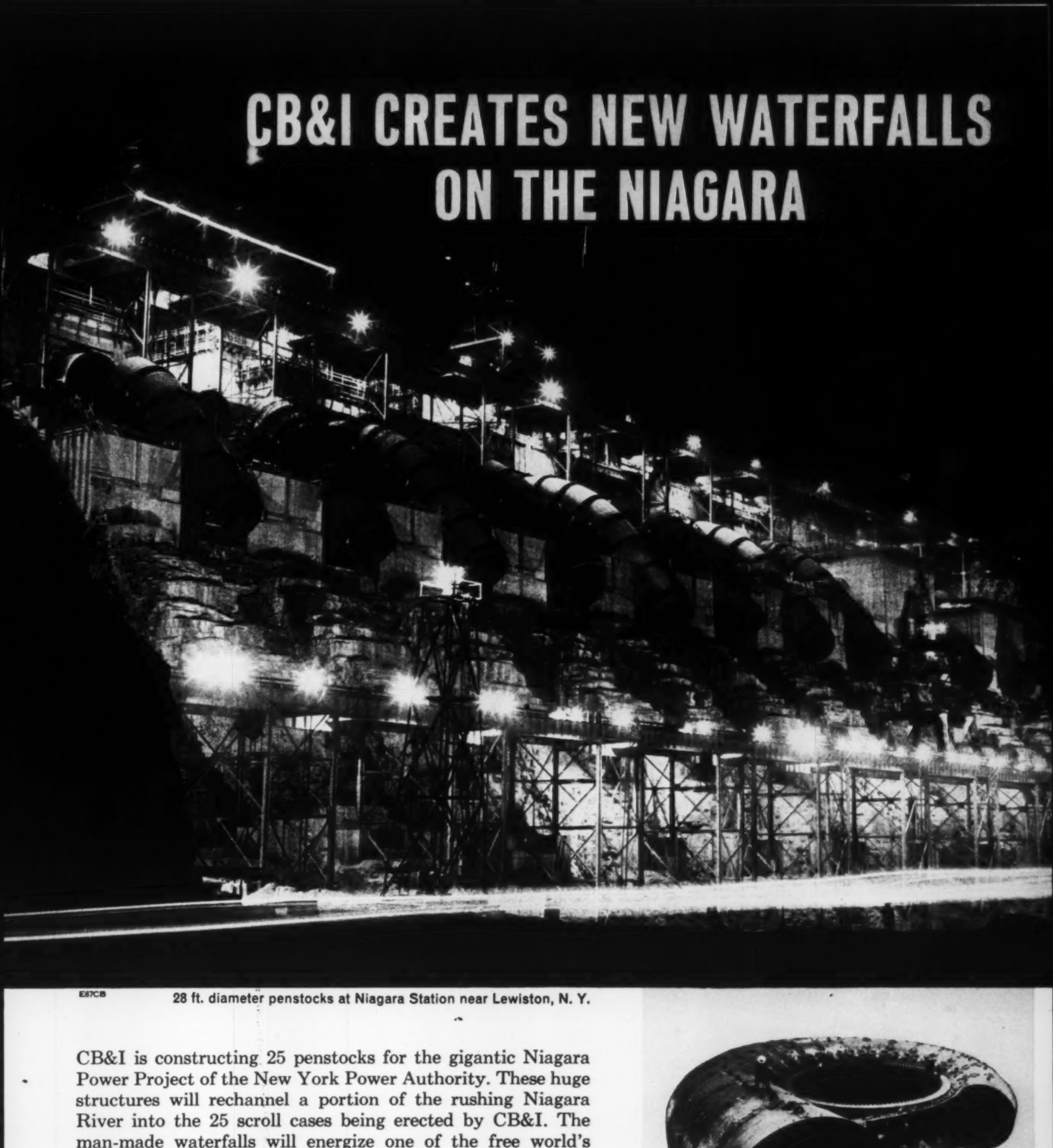
CB&I CREATES NEW WATERFALLS ON THE NIAGARA



E67CB

28 ft. diameter penstocks at Niagara Station near Lewiston, N. Y.

CB&I is constructing 25 penstocks for the gigantic Niagara Power Project of the New York Power Authority. These huge structures will rechannel a portion of the rushing Niagara River into the 25 scroll cases being erected by CB&I. The man-made waterfalls will energize one of the free world's largest hydroelectric plants.

CB&I's role in this vast construction project utilizes the *coordinated services* that have built an enviable world reputation for our company. The result is *Creative Craftsmanship in Steel*. Let us tackle your task in the same efficient manner.

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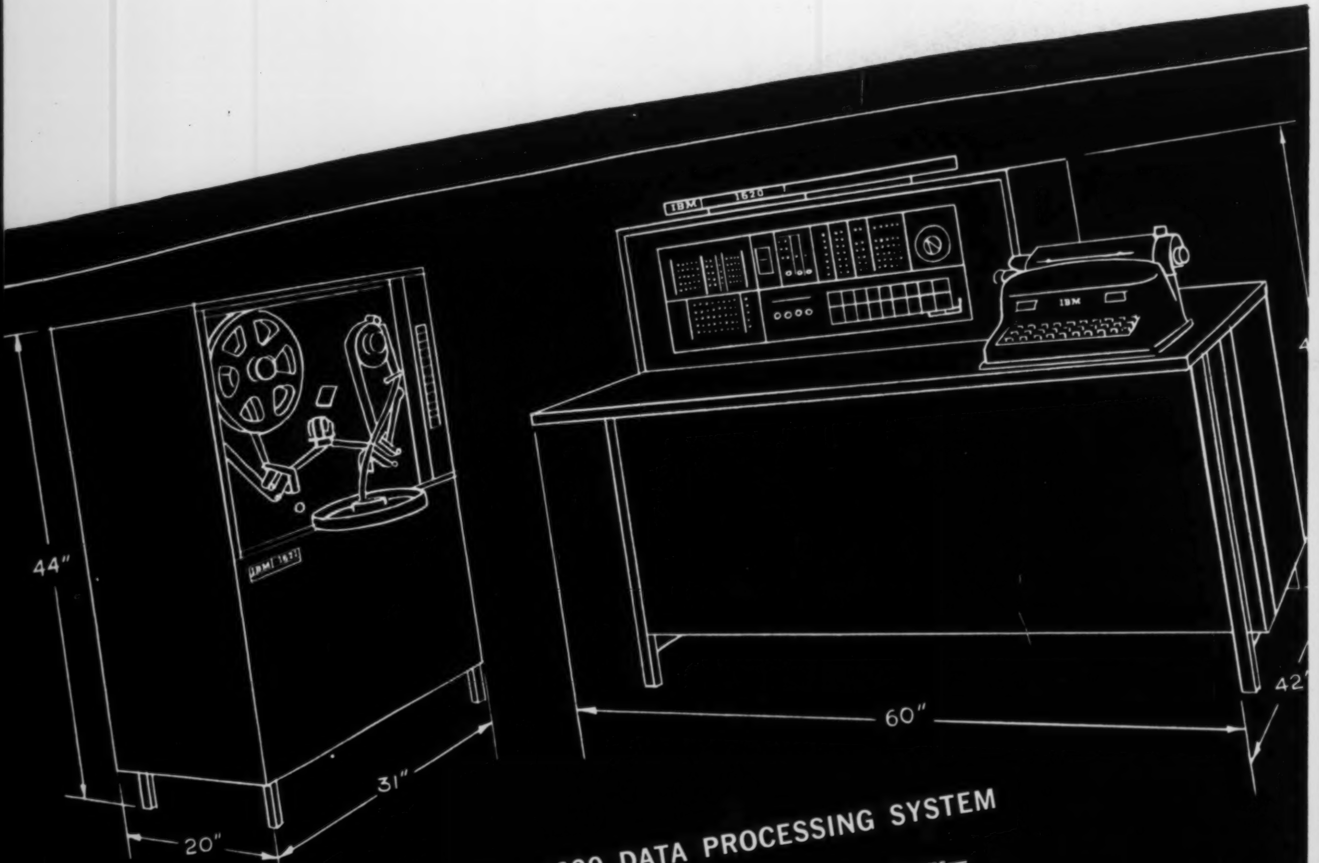
Giant scroll case dwarfs workman during "fitting-up" operation at CB&I's Greenville, Pennsylvania plant.



SPECIFICATIONS: IBM 1620 DATA PROCESSING SYSTEM

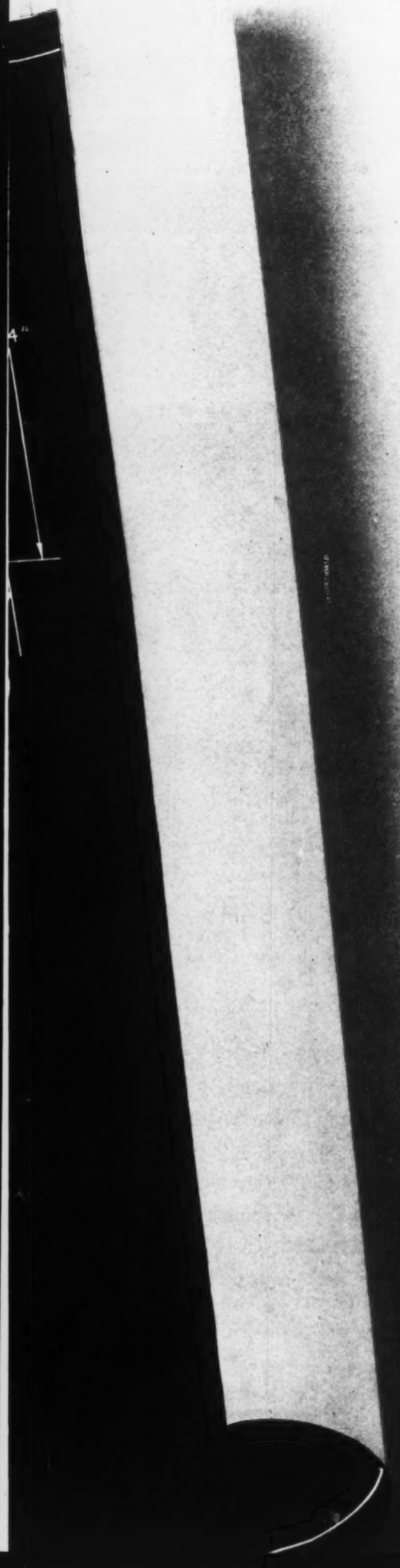
Core storage—20,000 digits
Automatic operation—stored programming
High computing speed—20 microsecond machine cycle
Powerful instructions with two data addresses
Decimal and alphabetic
Variable field and record length—any size numbers

Advanced programming systems—
Fortran and symbolic programming
Compatibility with other computers through Fortran
Simple console with logging features
Self checking throughout
Transistorized circuitry—
compact, economical, reliable
Paper tape input and output

The 1620 will meet technical computing requirements too complex for the conventional desk-type calculator. It provides many advantages of larger systems at a much lower cost. In addition, it can be used to support other data processing systems such as the IBM 650, 704, 705, 709, 7070 and 7090.

Information enters the system from the typewriter of the 1620 Central Processing Unit, or from the 1621 Paper Tape Reader. Output is to the typewriter or 961 Tape Punch.

Machine	Weight in lbs.	Current Requirements	Power cord	Interconnecting cable	Heat Load Specification BTU/Hr
1620	1,000	20 Amps., 115 Volts, single phase 10 Amps., 230 Volts, single phase 6.5 Amps., 208 Volts, three phase	10'3-Wire for 115 and 230 Volts 10'4-Wire for 208 Volts	10' signal 10' power	5,000
1621	280	——	——	——	2,000



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RELIEVES YOUR STAFF OF TIME CONSUMING WORK

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Problems that used to tie up your engineering staff for days can now be solved . . . with electronic accuracy . . . in minutes! The IBM 1620 is a low-cost, desk-size engineering computer that solves a tremendous range of routine and specialized engineering problems quickly and easily. The 1620 offers you an economical way to increase staff productivity, helps pave the way for profitable growth.

The 1620 is easy to learn, easy to operate, easy to communicate with. It adapts readily to specialized and general problems such as design development, blending problems involving matrix arithmetic, research calculations with differential equations. It facilitates the development of mathematical models for plant and shop operation, and evaluation studies employing statistical techniques such as regression analysis.

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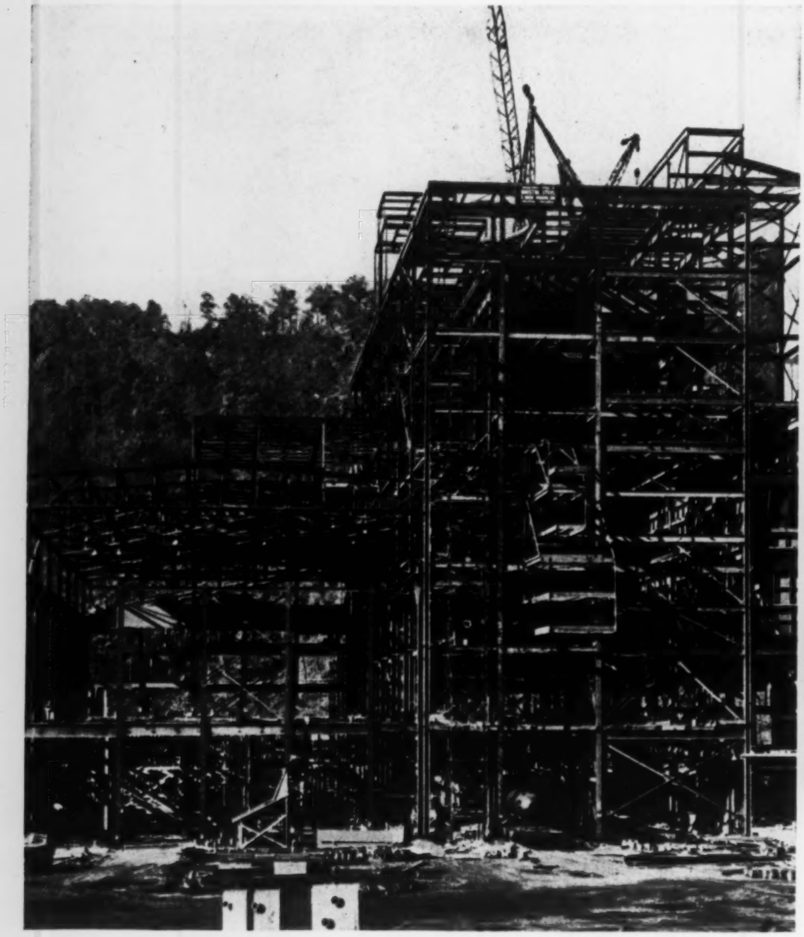
You can't see the forest for the steel

There's plenty of it in this Clinch River Plant of Appalachian Power Company. 7,460 tons of Bethlehem Shapes and Plates, to be exact. And it's all held together by 60 tons of Bethlehem Rivets and High-Strength Bolts.



◀ 7,460 TONS OF STEEL STRONG, this Clinch River Plant was designed and engineered by American Electric Power Service Corp. Bethlehem structural steel was fabricated and erected by Bristol Steel & Iron Works, Inc.

▲ HIGH-STRENGTH BOLTS go in fast. They hold tight, stay tight. Bethlehem supplies a full-size range to meet every construction need.

Located on a 105-acre site near Carbo, Virginia, this $60-million plant has two 225,000-kilowatt turbine-generators which can provide electric service to 650,000 average homes. Three 138,000-volt transmission lines link the plant to Appalachian's far-reaching transmission system, and to the remainder of the seven-state American Electric Power System.

Plant construction began in mid-1956. By October 1, 1958, the plant was already operating. 7,460 tons of Bethlehem structural steel (shapes and plates), and 60 tons of Bethlehem rivets and high-strength bolts, went into the structure.

Whether you're building steam-generating stations or churches, highway bridges or shopping centers . . . our nearest sales office stands ready to give you full details. Give us a call today. Or write to us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

NEW CAT DW20-482 TEAM

HAULS BIG LOADS FAST, INCREASES PRODUCTION

Six-minute cycles on nearly a two-mile round trip hauling 24 bank cu. yd. of slow-loading sand! This is the production from two big Cat DW20G Tractors with new 482 Scrapers speeding road construction on State Highway No. 99 in Marshall County, Oklahoma. The big rigs are owned by the W. D. Jeffrey Construction Company of Fort Smith, Arkansas, contractors on this job.

"The new DW20 and 482 Scraper have a faster cycle and loading time which means higher production," comments Superintendent "Smoky" Branson. He adds, "Down time on equipment is minimum."

The DW20's 345 HP results in 12% increase in rimpull over the former model. This provides up to 20% faster travel speeds under similar haul road conditions. The 482 Scraper is teamed with the DW20 for high production with its 24 cu. yd. struck load capacity (34 cu. yd. heaped). On this job the DW20-482 combination loaded in .93 minute.

Field reports from contractors all over the country confirm the productive efficiency of the big DW20-482 combination. Get the facts from your Caterpillar Dealer. He can prove—right on your job—that economical, high production is built into the new DW20 and 482.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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PICK THE DW20-482 TO BREAK PRODUCTION RECORDS

FOR HIGHWAYS WITH
A SOLID FUTURE...
Concrete

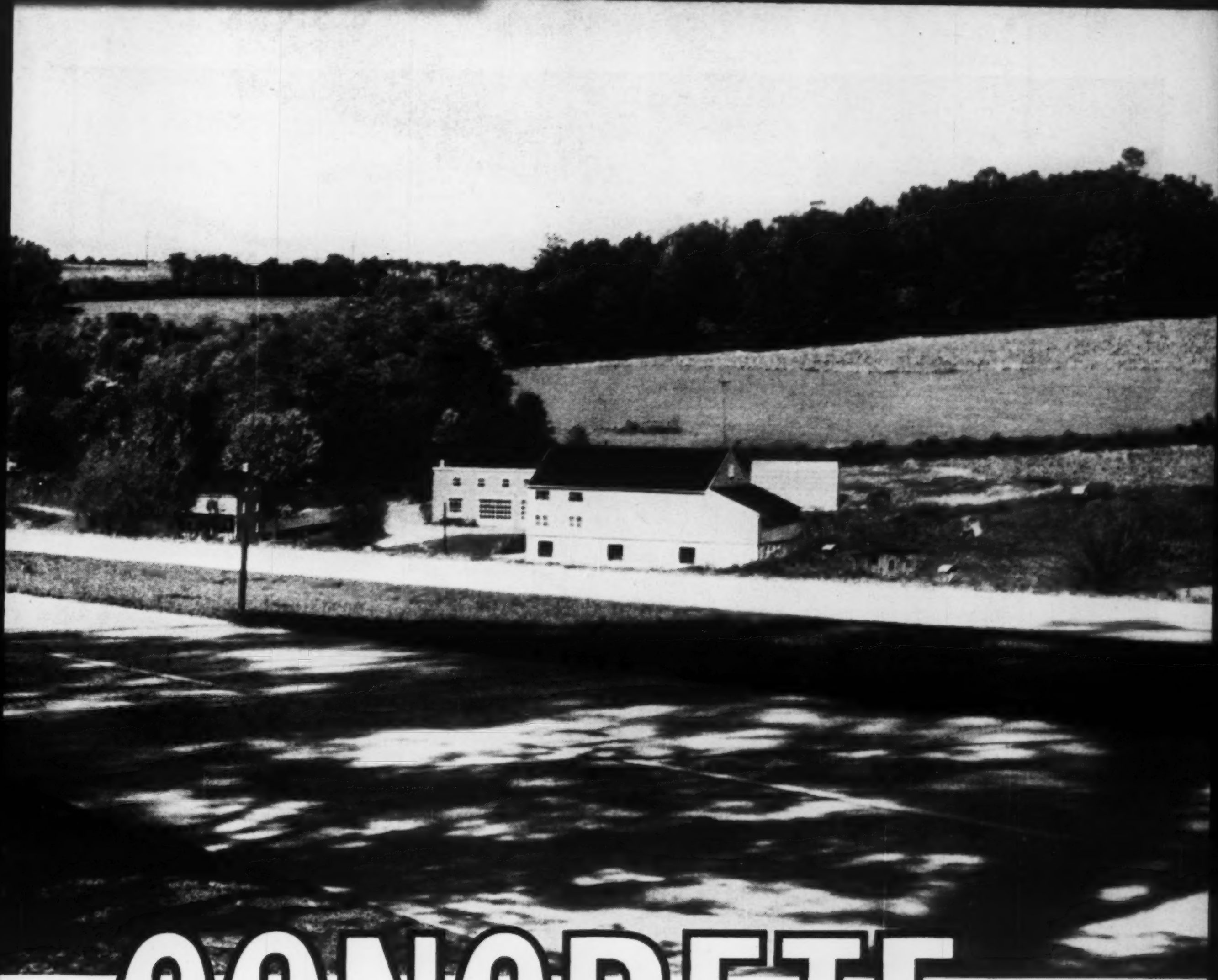
INTERSTATE
MARYLAND
83
INTERSTATE
PENNSYLVANIA
83

Newest Interstate route to be completed

...the pavement that stays completed...

Concrete saves 69% on upkeep during first 3 years on Oklahoma Test Road. Oklahoma laid connecting two-mile sections of concrete and asphalt, the best of each type. Exact records of all pavement upkeep costs show, three-year total per mile: concrete, $229.98; asphalt, $745.11. So far concrete has actually saved $515.13 per mile!

TEST ROAD
BEGIN PORTLAND CEMENT
CONCRETE SECTION
END ASPHALTIC
CONCRETE SECTION



in CONCRETE

saves up to 60% on upkeep!

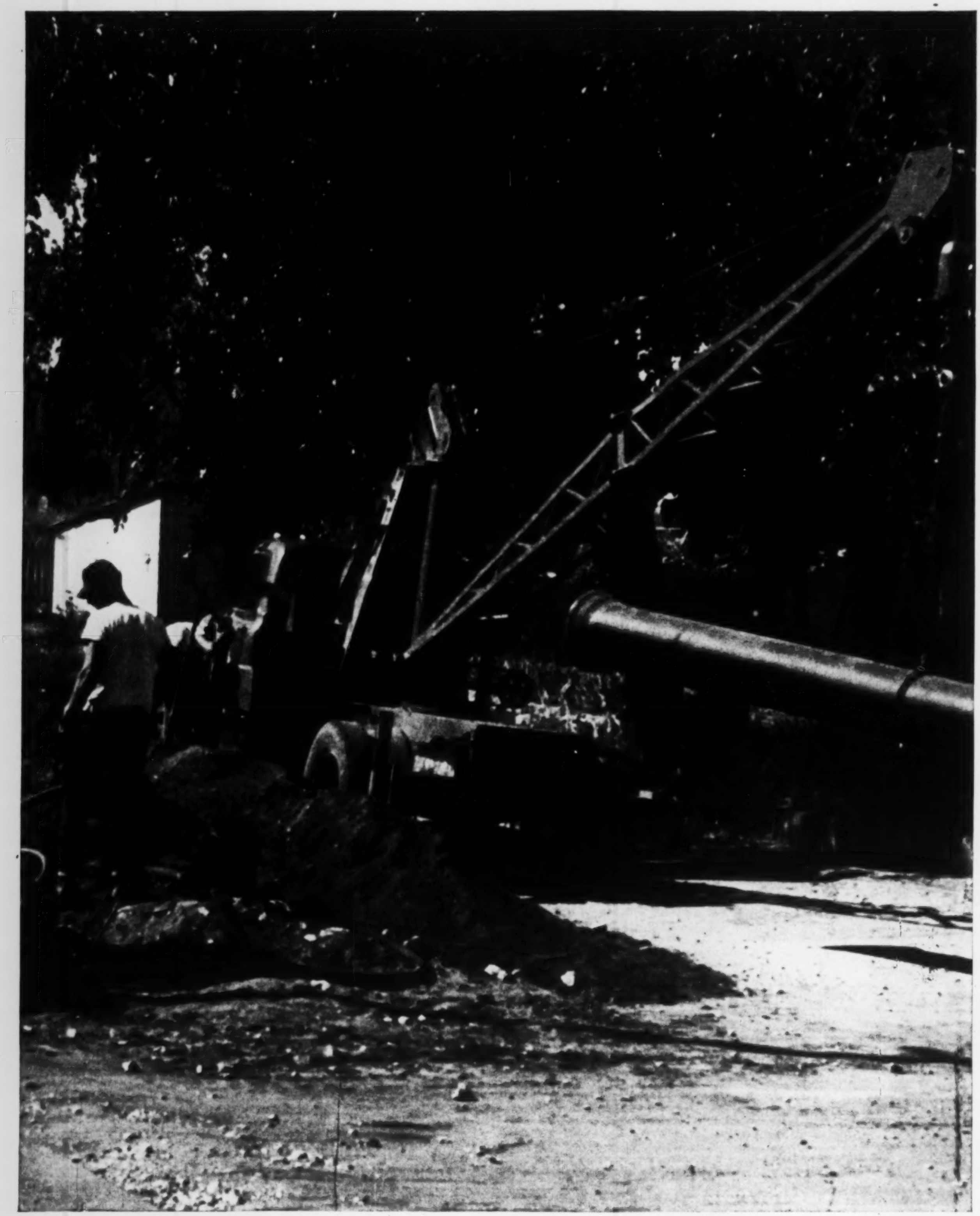
Already open for traffic, Interstate 83, from Baltimore, Maryland to Harrisburg, Pennsylvania, soon will have *four* lanes of concrete all the way as the last few miles are completed. This Interstate highway won't be wearing detour signs! Only concrete has load-bearing strength that can be computed *mathematically* to match future traffic. Only concrete enables engineers to design highways to last 50 years and more!

There are no "moving parts" in concrete to cause hidden wear. And even under the highest temperatures concrete doesn't get soft. Traffic can't push its solid surface into ripples.

Concrete can't oxidize . . . there is never any adverse chemical reaction to sun, cold, air or moisture. So it doesn't dry out, lose strength and need expensive surface build-up treatments every few years. Then, too, concrete actually grows stronger year by year.

All these engineering and material advantages of concrete add up to built-in thrift. Exceptional pavement life—and upkeep costs that will run as much as 60% less than for asphalt. That's why you can look for more and more Interstate routes going concrete all the way!

PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*



GOES TO BED WITH ITS WORKING CLOTHES ON

From the moment it is installed, cast iron pipe begins working—will deliver its full flow of water for over a century.

Here in Kansas, as part of a major water expansion program, 15,000 feet of cast iron pipe were put to bed. Ease of assembly, bottle-tight joints, and assured full-flow capacity through cement lining were important factors in the selection of cast iron pipe.

An interesting feature was the uncovering of distribution mains constructed of cast iron pipe manufactured in 1887. The pipe was in excellent condition and was put back in water service.

Cast iron pipe is always working. In fact, once it is installed, one can generally anticipate no major repairs or replacements for at least a century.

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

How to change bridges in the middle of a stream

Since 1888, a swing span carried trains over the south channel of St. Mary's River at Sault Ste. Marie, Michigan. It rested on an island that presented a constant navigational hazard. ☐ In 1957, the Corps of Engineers and the Sault Ste. Marie Bridge Co. decided to eliminate the hazard by removing the relic and the island and building a modern lift span. But neither rail nor water traffic could be interrupted, so both construction and scheduling problems were involved. ☐ Work began in the fall. First, the swing span was **bob-tailed** on both ends, permitting towers to be built directly over the existing abutments. The towers were completed by mid-December, when the river froze over and halted water traffic. Then the swing span was swung across the river, a falsework tower was erected over the pivot, and the lift span was built **piggy-back** about 65′ above the span. This part of the job was completed before the mid-April thaw when river traffic resumed. ☐ With the lift span completed, we were given a weekend to place the swing span perpendicular to the river and hack out enough of its mid-section to permit the lift span to be lowered to track level and accommodate rail traffic Monday morning. This was accomplished in round-the-clock operations. The new bridge features a 369′3″ long lift span, supported by two 177′ towers. The island will be ripped out by mid-year, and the channel deepened. Write for information on our construction services, or call our contracting office nearest you. ☐ Bridge owned by the Sault Ste. Marie Bridge Co., which is jointly owned by the Canadian Pacific Railway Co., the Soo Line Railroad, and the Duluth, South Shore and Atlantic Railroad. Bridge designed by: Howard, Needles, Tammen & Bergendoff, Kansas City, Mo.

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Division of
United States Steel

USS

A sensational, block-long stained glass facade distinguishes American Airlines' new terminal at New York's International Airport. Designed in the "customer-centered" concept, it includes such conveniences as covered jetways that move from lounge to liner, split-level construction to promote smooth flow of traffic, restaurant and bar facilities, and private dressing rooms and showers for passengers. A complex machine in itself, this terminal rises on a foundation of 1635 Raymond step-taper, standard and wood piles. On thousands of projects huge and small, Raymond plays a vital though unseen role in linking the nation together. Ground-bound and prosaic indeed, Raymond foundations support many of the finest structures in America's communications network. Whether or not your next project presents any special foundation problems, and regardless of its nature or size, we shall be happy to consult with you.

A Division of Raymond International Inc.

RAYMOND

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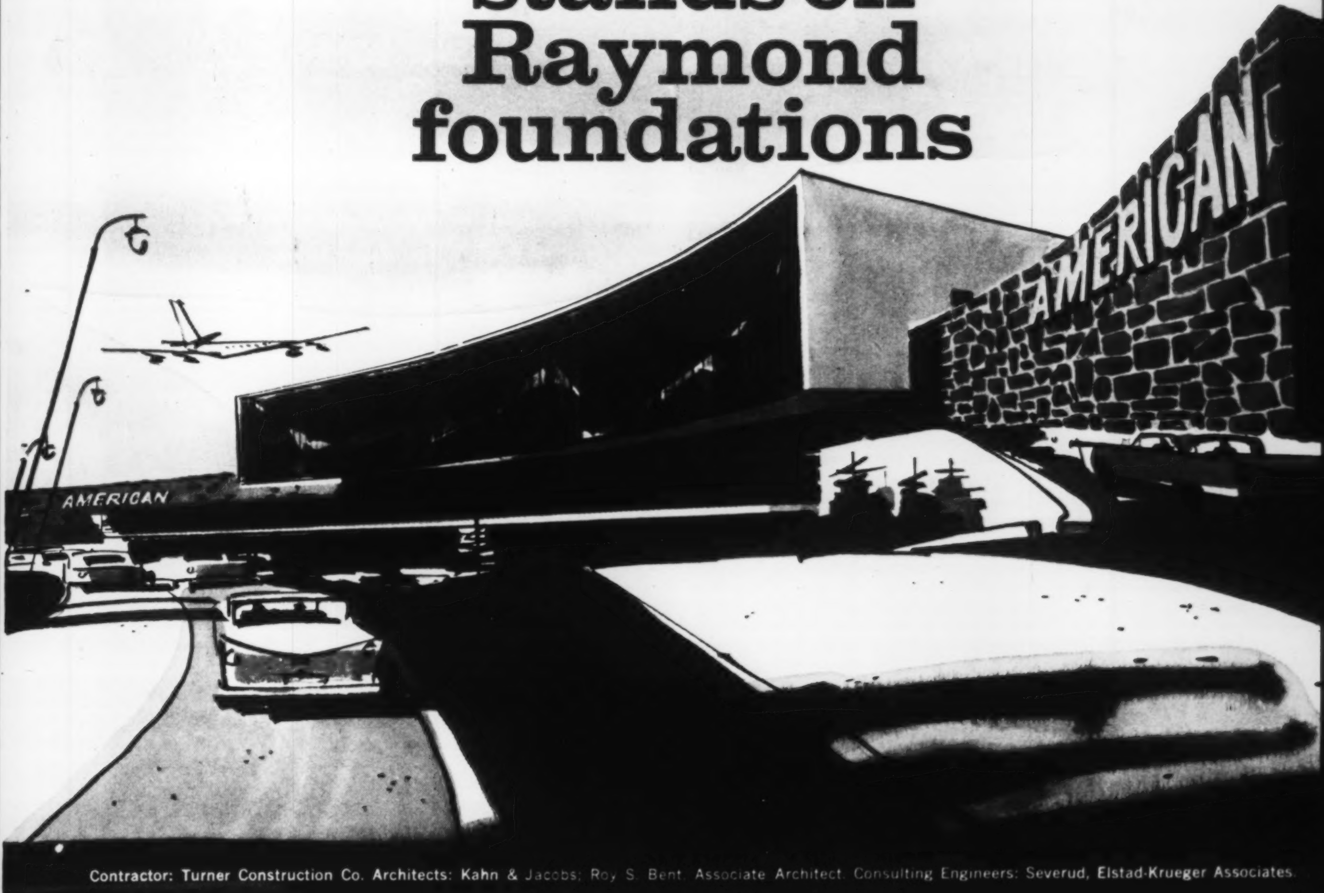
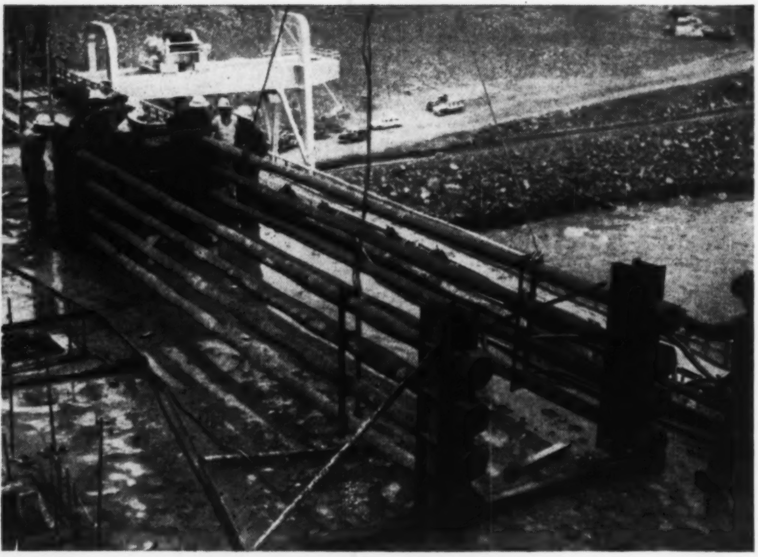
Foundations for the Structures of America•Complete Construction Services Abroad

New jet air terminal stands on Raymond foundations



Contractor: Turner Construction Co. Architects: Kahn & Jacobs; Roy S. Bent, Associate Architect. Consulting Engineers: Severud, Elstad-Krueger Associates.

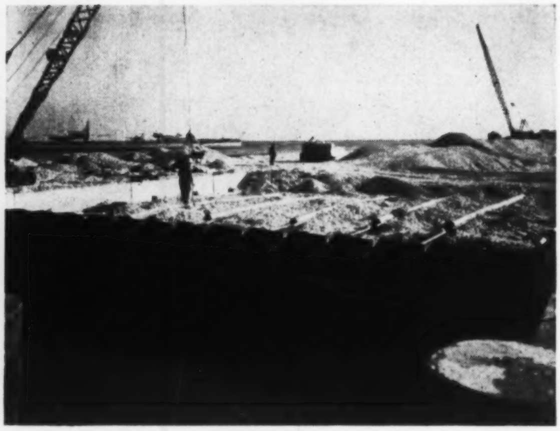


GIGANTIC UPSET ANCHOR BOLTS, some of the world's largest, secure 8 tainter gate assemblies in this mile-long, 400,000 kw capability, hydroelectric power project. Imbedded and anchored in concrete, these tension bolts absorb tremendous gate thrust load from upstream water pressure, as their projecting threaded ends secure the gate-supporting bearings.

Noxon Rapids Dam, Sanders County, Montana
The Washington Water Power Co., Morrison-Knudsen, Contractor

FURNISHED COMPLETE BY COMMERCIAL these ton-weight bolts are 33½ feet long, 5½ inches in diameter. Ends are upset to 6¼ in. diameter for a length of 9 inches. Both headed ends are threaded—one end receives the deadman anchor sleeve to be buried in concrete—the other end takes a hex nut to secure the gate bearing. At no sacrifice of strength, upset heading saves 750 lbs. of steel—28%—on each bolt.

How to anchor big jobs!



100 FT. LONG TIE ROD ASSEMBLIES, complete with turnbuckles, washers and nuts, tie into the continuous wales every 7 feet and anchor the land fill retaining wall. The threaded ends of these 600 lb., 2¼ in. rods are upset by COMMERCIAL to a headed diameter of 2⅞" for maximum strength without excess weight.

Lakefront Land Fill, Chicago Exposition Hall
Lake States Engineering Corp., Contractor

CHANNEL WALES COMPLETE with spacers, washers and nuts, reinforce latest Chicago lakefront land fill. COMMERCIAL double-channel wales span the entire facade of the future exposition hall site. Separated by 3¾" pipe spacers, two 12" channel wales furnished in 10 ft. sections are spliced into a continuous reinforcement for the vertical steel pilings. Loads and stresses due to extensive fill on one side and wave action on the other are stabilized.

You'll find COMMERCIAL the top "one-source" for wales, tie rods, large anchor bolts, special fasteners, handrail and curbing for heavy construction. Write to Commercial Shearing & Stamping Company, Dept. C-23. Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping

CATERPILLAR ANNOUNCES 2 NEW TRAXCAVATORS

with Power Shift Transmission and Live Action Hydraulics

977H 150 HP 2½ cu. yd. bucket

955H 100 HP 1¾ cu. yd. bucket

There is a way to beat higher costs—and that's with increased production. For tractor-loader jobs, here's your answer in the new Cat Series H 977 and 955 Traxcavators. Designed to set a pace far faster than the models they replace (and other makes of comparable size), they're milestones in tractor-loader progress. With power shift transmission and Live Action Hydraulics, they're *the loaders that never stop.* Get the facts about them from your Caterpillar Dealer. Ask for a demonstration, too. See for yourself how they set new production figures on the toughest kind of job.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

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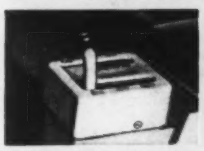
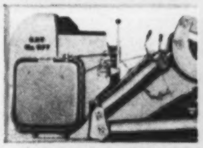
TRAXCAVATORS ARE MAKING OTHER LOADERS OBSOLETE

NEW FEATURES SPEED LOADING, LIFTING, HAULING, DUMPING . . . THE FULL CYCLE



NEW POWER SHIFT TRANSMISSION. One lever—that's right, one lever gives split-second changes in speed or direction to slash cycle times and increase operator efficiency.



NEW LIVE ACTION HYDRAULICS. Provide faster lifting speed and greater lifting capacity without robbing power from the tracks.

MORE HP WITH NEW CAT TURBOCHARGED ENGINE. Up 50% on the 977H—up 43% on the 955H.

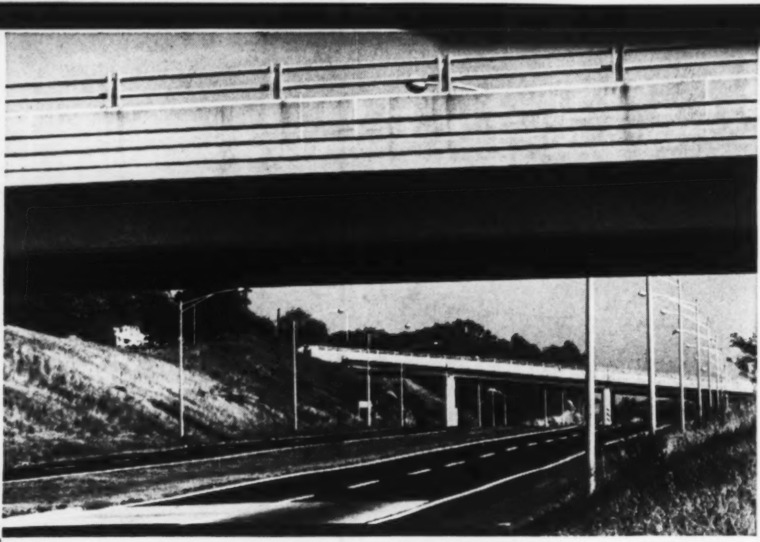
NEW INCREASED BUCKET CAPACITY. An 11% increase on the 977H—a 16.6% increase on the 955H.

NEW HEAVY-DUTY UNDERCARRIAGE. Larger, stronger track components also increase stability . . . lifetime lubricated rollers with exclusive floating ring seals need no servicing.

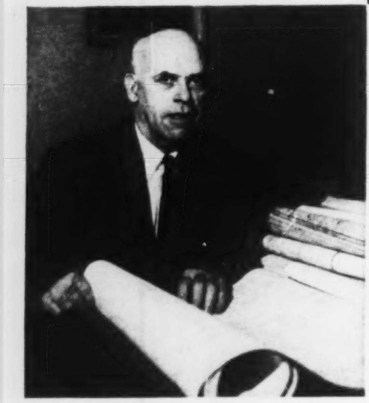
MORE HIGH-PRODUCTION FEATURES. New gasoline starting engine . . . new dry-type air cleaner that cuts maintenance time as much as 75%. Plus such retained features as 40° bucket tilt back . . . automatic bucket positioners and kick out . . . hydraulic track adjusters.

QUICK-CHANGE ATTACHMENTS. Multiply the usefulness of these machines. Attachments available include the Side Dump Bucket, Rock Bucket, Quarry Bucket, Bulldozer, Ripper and Log and Lumber Forks.

Keep our roads on the GO



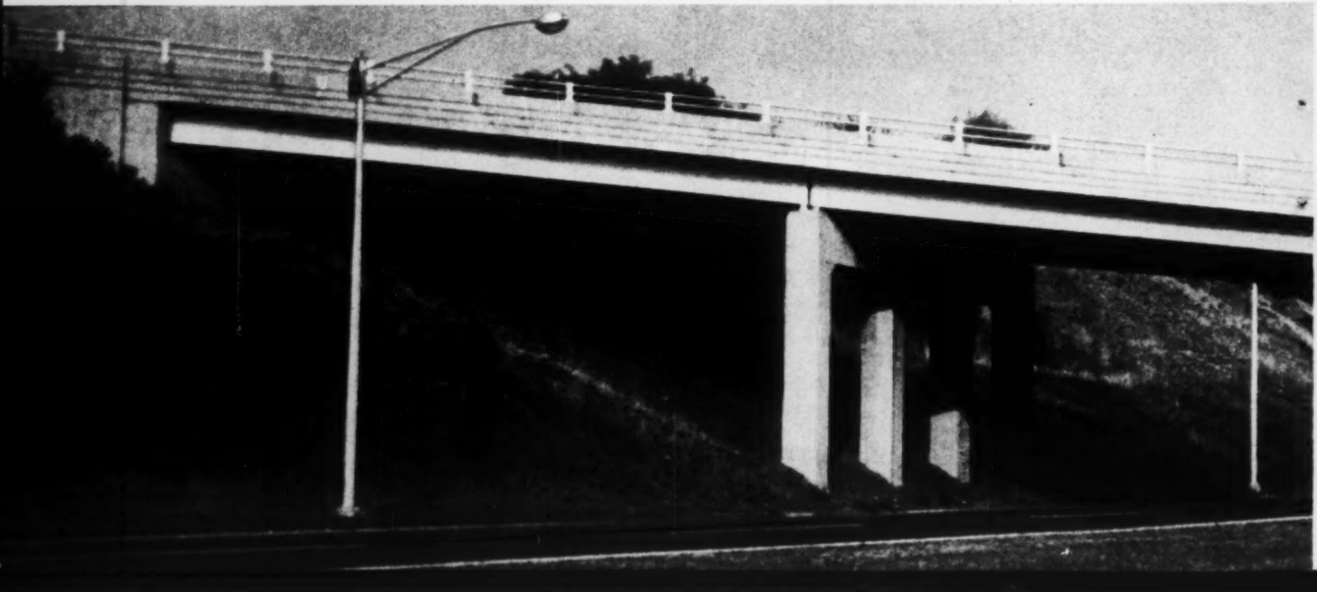
Steel construction offers adequate clearance and reduces height of approaches.



Mr. Harold S. Woodward, partner, Seelye, Stevenson, Value and Knecht, agrees that nothing is easier to design with than steel.

Mr. Williams D. Bailey, partner of the firm (left) supervises steel designs with his assistant, Mr. R. F. Shumaker (center), and Mr. Melvin Leonard.

Short-span steel bridge over the Connecticut Turnpike. Simple design saves engineering time and erection costs.



Steel specified in over 95% of short-span bridge designs

at Seelye, Stevenson, Value & Knecht, Consulting Engineers, New York, N.Y.

The Bridge and Highway Division of this engineering firm deals almost exclusively in the design of short-span bridges from 100 to 125 feet long. In the past few years, the firm has designed bridges for the New York Thruway, the Connecticut Turnpike, and large projects in Ohio and Virginia. More than 95% of these bridge plans specify steel construction, according to Mr. Harold S. Woodward, partner in the firm.

Reasons for favoring steel construction. There is nothing easier to design with than steel . . . it takes only a fraction of the time for the designers to draw their plans, because considerably fewer mathematical calculations are required. If changes have to be made, it is relatively simple with steel design. With some other forms of construction, any changes may mean redesigning the entire structure—a costly waste of professional manpower.

Steel is available. This factor deserves serious consideration on any job. Steel is readily available and can be transported quickly and simply to the job.

Steel goes up quickly. Bridge spans must be constructed with least interference to traffic. The speed with which steel can be erected without normal traffic interruption is a big advantage.

Steel permits maximum headroom—also, minimum approach alteration. According to Mr. Williams Bailey, another partner in the firm, the use of slender steel beams keeps overpass approaches at a minimum in congested areas, and makes it possible to allow for tight clearances with minimum disturbance to established roads and buildings.

Steel reduces costs. Light construction with steel reduces foundation costs, and faster erection saves labor. New high-strength steels offer greater strength with even less bulk.

United States Steel and the steel industry in general have greatly *expanded facilities* for manufacture of structural shapes and plates. You can confidently design in steel—the material you know best, and the material that offers most—knowing it will be available.

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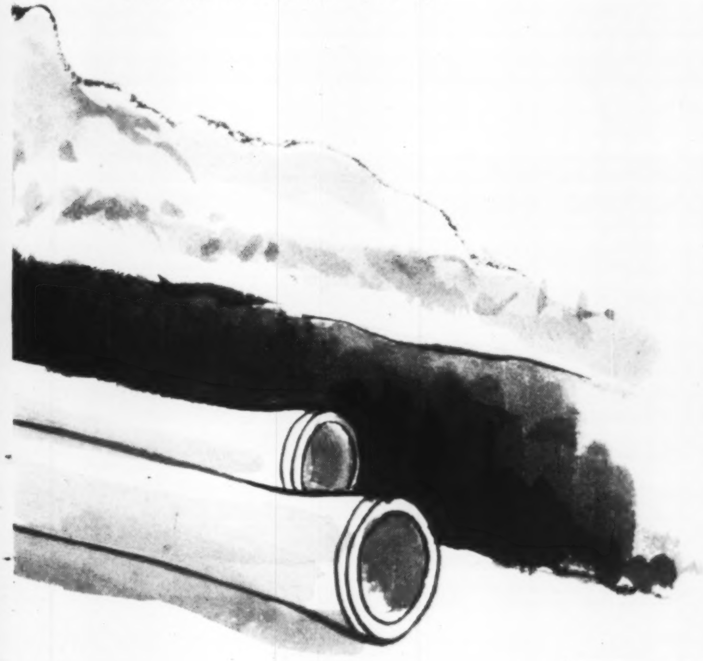
and Blast Furnaces to Finished Pipe.



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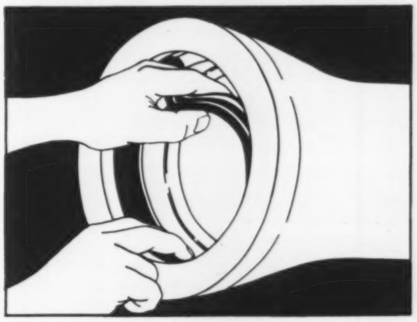
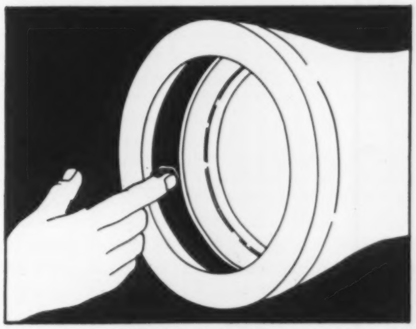
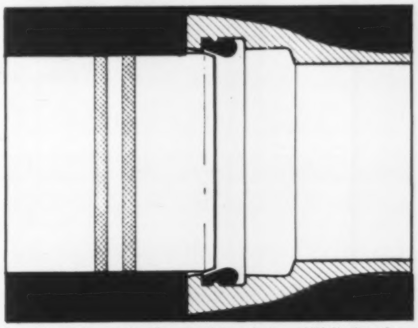


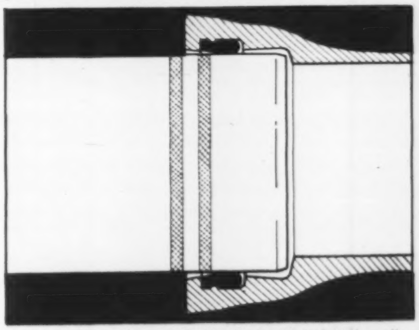
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

CONCRETE PERFORMANCE REPORT:

POZZOLITH lends 5000 psi concrete high degree of workability in interesting new structure

Phillip Johnson's new Munson-Williams-Proctor Institute Art Gallery in Utica, New York, features a unique structural system. In it, Dr. Lev Zetlin's use of engineering theory and imagination combine to produce a building of outstanding practicality. Many catch-phrase titles have been applied to the prestressed concrete structural system, which Dr. Zetlin himself calls a "two-way lattice girder". Others, after a glance at the huge monolithic system of two parallel pairs of concrete beams which intersect at right angles to form a single monolithic girder, have mentioned its resemblance to a gigantic game of tic-tac-toe.

Actually, the *monolithic structural system* of cast-in-place, post-tensioned concrete is completely functional, and results in an interior free of supporting columns. The four sections were monolithically cast in one huge concreting operation and are supported only at their extremities. According to Dr. Zetlin's computations, the resulting single girder provides a strength and rigidity equal to eight similar parallel girders, or *sixteen 2' x 2' interior columns.*

This huge girder, consisting of four 123'10" sections, was cast-in-place more than fifty feet above grade. Within their 10'9" x 22" cross-section, each of its four sections contains 14 flexible, hollow conduits for the post-tensioning cables, four 4" hollow sleeves for balcony rods and several types of reinforcing bars in diameters up to ½".

This complexity of steel, coupled with the need for a continuous placement of concrete to provide a truly monolithic girder, required special considerations in the design of concrete. Dr. Zetlin's structural system required a concrete mix which met these four specifications:

First, 5000 psi compressive strength for economical utilization of prestressed concrete and to meet the prescribed design loads.

Second, to assure a monolithic member completely free of horizontal cold joints and honeycombing, the hardening of the mix had to be retarded.

Third, a high degree of workability was required because of the complexity of steel reinforcement and delicate positioning of conduits within each section.

Fourth, a low unit-water content for minimum shrinkage and over-all improvement of concrete quality.

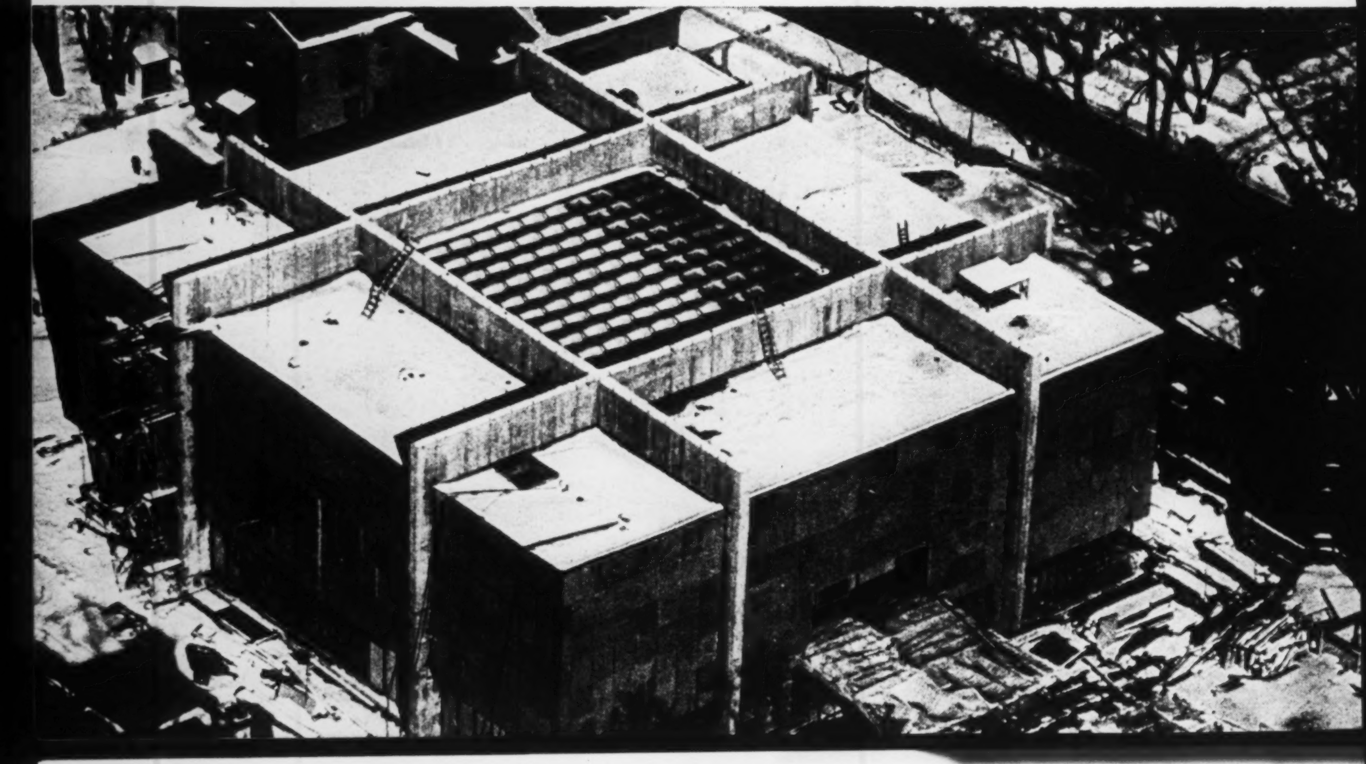
Cooperative effort by the local Pittsburgh Testing Laboratory, the Alpha Portland Cement Company and the local Master Builders field men, developed the following mix design:

Type I Alpha
Portland Cement— 668 lbs.
Sand—1240 lbs.
#1 Stone— 550 lbs.
#2 Stone—1280 lbs.
Water— 32 gals.
POZZOLITH Retarder— 1.78 lbs.

The mix had excellent workability and was easily placed with only 3½" slump. It contained 20% less water than a comparable plain mix. A companion mix with 2½" slump was also designed for use during later stages of placement to insure equal rate of hardening.

Placing operations began at 8 a.m. with two crews of the George A. Fuller

UTICA ART



Co., General Contractors, New York City, starting at adjacent corners and working across the top of the building. Two cranes supplied the POZZOLITH ready-mixed concrete from the American Hard Wall Plaster Co., Utica, as the crews worked their way across the top of the structure. At 5 p.m., another crew and crane joined in, and shortly after midnight placing was completed. During the 16-hour, continuous concreting operation—approximately 360 cubic yards of concrete were placed in the intricate forms . . . and POZZOLITH helped assure a truly monolithic structure by retarding the hardening of the mix to eliminate cold joints.

Seven-day breaks on test cylinders averaged 4200 psi, 14-day breaks averaged 4985 psi and 28-day breaks averaged 5665 psi. Two weeks later, the girder was post-tensioned by Pre-Stress, Inc., of Albany, employing the P.I. system of anchorage.

POZZOLITH concrete was used throughout this building—from the intricate lattice-work of cast-in-place concrete ribs which spans the central bay, to the massive walls of lightweight concrete which seem to float on a ribbon of glass at grade level. The hung balcony around the perimeter of the interior and its cantilevered reinforced concrete stairway also contain POZZOLITH.

Utica's Munson-Williams-Proctor Institute Art Gallery stands as a unique and significant engineering achievement, and an example of the great utility and versatility of modern POZZOLITH concrete, one of today's most economical and exciting building materials. It is also evidence of the benefits of close cooperation between creative architects and engineers, and the suppliers and builders who turn their designs into realities.

POZZOLITH and Master Builders Field Service—From early planning through completion of the job, the consulting engineers, contractor and ready-mix producer had the full cooperation of the Master Builders field men. These experienced field men utilized Master Builders technical products and know-how to achieve uniform concrete of superior quality, at lowest cost-in-place.

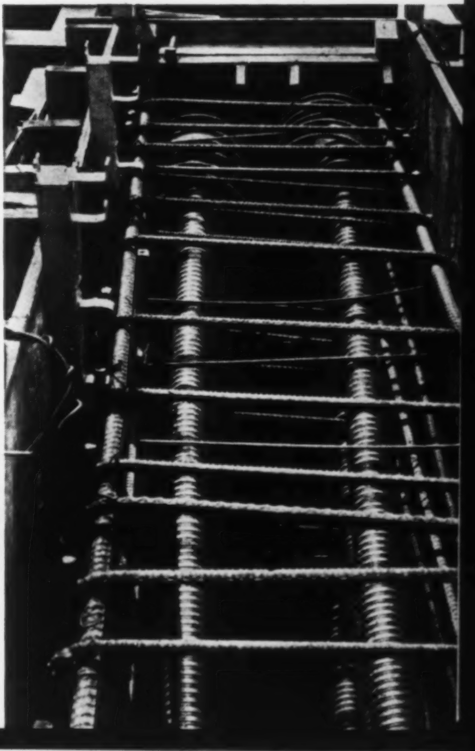
To better meet concreting requirements on your current and future projects—call in the local Master Builders field man. At no cost, he'll demonstrate—with your materials—how concrete produced with POZZOLITH becomes a more versatile and more useful building material...superior in performance, in quality and in economy to plain concrete or concrete produced with any other admixture.

CONTINUOUS 16-HOUR PLACEMENT OF CONCRETE—To assure a completely monolithic member, all concrete for the girder was placed in a single, continuous operation. POZZOLITH retarded the hardening of the mix during placement, preventing horizontal cold joints.

GALLERY

◀ **HUGE PRESTRESSED MONOLITHIC GIRDER**—The structural system, weighing 720 tons, and containing over 360 cubic yards of 5000 psi concrete was cast-in-place 50 feet above grade. The girder supports roof and hung balcony without interior columns. Facade will be covered with black Canadian granite, while girders and their supporting columns will be sheathed in bronze.

THE MAZE OF REINFORCING STEEL and 14 flexible conduits for the post-tensioning cables made high workability a must in the concrete mix design. Use of POZZOLITH permitted a sharp reduction in water content, yet gave a highly workable mix with 3½" slump. ▶



THE MUNSON-WILLIAMS-PROCTOR INSTITUTE ART GALLERY was designed by architect Phillip Johnson and engineered by Dr. Lev Zetlin, both of New York City. Supervising architects were Bice and Baird of Utica. The George A. Fuller Company, New York City, built the art gallery, with Jack Madden as project supervisor and William Gardner as engineer. The American Hard Wall Plaster Company, Utica, supplied the POZZOLITH ready-mix concrete. Pre-cast roof sections were supplied by Schenectady Concrete Products. Post-tensioning was by Pre-Stress, Inc. of Albany.

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NEWS OF MEMBERS

John B. Gribbin (see photo), associate professor of civil engineering at Manhattan College, New York City, has been named assistant to the dean of engineering, **Brother Amandus Leo.** In his new post he will assist in the administration of the College's expanded engineering curriculum. Professor Gribbin is also senior member of John B. Gribbin Associates, engineering consultants of Westwood, N. J. Brother Leo, for the past 30 years dean of the School of Engineering, will head the Association of Engineering Colleges of New York State during 1960 and 1961.

Joseph H. Shea has been appointed chief of the Army Corps of Engineers' newly organized Ballistic Missile Section in the Los Angeles District. Until recently he was chief of the Corps' Army Section in the Los Angeles District. In his new capacity he will serve as liaison between the Ballistic Missile Division in Inglewood and the Corps of Engineers, which performs the basic construction work on missile sites.

George B. Sheldon, Jr., who recently retired as chief of the design and construction division, Region 3, General Services Administration, has joined the Norair Engineering Corporation, of Washington, D. C., as vice-president in charge of industrial products. His recent work with GSA included repairs and improvements to many federal buildings and a $200 million construction program.

Howard Hugh Harris, since 1923 a Virginia State Highway Department employee, has been appointed Virginia Highway Commissioner to fill the remaining two years of the unexpired term of the late Samuel D. May. At the time of his promotion Mr. Harris was executive assistant to the state highway commissioner.

Frank A. Small retired recently as Montana state highway division engineer. His retirement ended a 37-year career with the department.

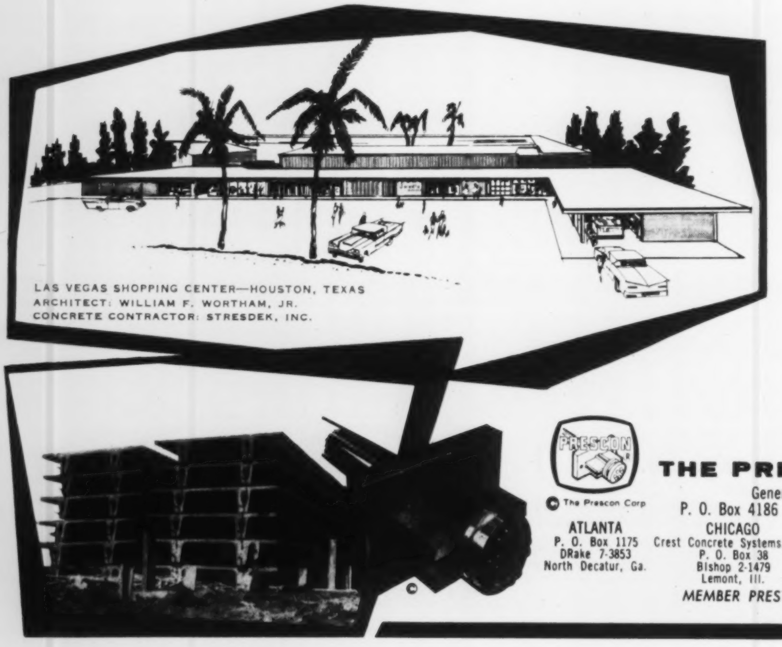
Thomas A. Lane, Major General, Corps of Engineers, and Commanding General of the U. S. Army Training Center at Fort Leonard Wood, Mo., has been nominated by President Eisenhower to be president of the Mississppi River Commission. In his new capacity, General Lane will also serve as the Army Corps of Engineers' Lower Mississippi Valley division engineer, with headquarters at Vicksburg. He will replace Maj. Gen. **William A. Carter, Jr.,** who is being assigned as Governor of the Panama Canal Zone. The appointment is subject to confirmation by the Senate.

Frank E. Dalton has joined the civil engineering department of the Chicago firm, Meissner Engineers, Inc., as project engineer. He has supervised the engineering design of portions of interstate highway programs for Indiana, Wisconsin, and Illinois, including structural design of prestressed concrete bridges for the latter two states.

Carl W. George, Jr., has opened consulting structural engineering offices at 1940A Sherwood Way, San Angelo, Tex. A 1953 graduate of the Texas Agricultural and Mechanical College, Mr. George has been associated with W. R. Matthews & Associates, of Bryan, Tex., and Architect Donald R. Goss, of San Angelo.

Ralph Bird, city engineer for the city of Lighthouse Point and for Cooker City in Broward County, Fla., has formed a partnership with **James D. Payne** with offices at 620 E. Atlantic Avenue, Delray Beach, Fla. Mr. Bird is a former chief engineer of Tidewater Engineers, Inc., of Pompano Beach, Fla.

The Prescon System of Post-Tensioning Prestressed Concrete Works for You From Design and Engineering to Completion



LAS VEGAS SHOPPING CENTER—HOUSTON, TEXAS
ARCHITECT: WILLIAM F. WORTHAM, JR.
CONCRETE CONTRACTOR: STRESDEK, INC.

More design flexibility to achieve esthetic effects and meet engineering demands can more often be done with post-tensioned prestressed concrete.

The Prescon System offers the simplest and most economical method, both from design and construction standpoints. The system is adapted to either yard or job site use.

If you are not acquainted with design and construction using post-tensioned prestressed concrete and The Prescon System, contact any Prescon Representative. For technical data see Sweet's Catalog.

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MEMBER PRESTRESSED CONCRETE INSTITUTE

R. W. Fisher, Jr., recently named a vice-president of the Kaiser Engineers Overseas Corporation, will take up residence in Bangalore, India, as project manager of a 100,000-ton per year portland cement plant being designed and constructed for Mysore Cements Ltd., at Ammasandra, Mysore State, India. Prior to his new assignment, Mr. Fisher served as principal engineer with Kaiser Engineers, a division of the H. J. Kaiser Company, Oakland, Calif.

Nathan S. Ellis is now associated with Corse and Tibbetts, consulting engineers of Marion and Rochester. Commissioner of public works at New Bedford, Mass., since 1956, Mr. Ellis is expected to render valuable service to the firm which handles civil engineering work both for municipalities and private business.

Edward A. Miller has been elected president and chief executive officer of Fenestra, Inc., Detroit building products manufacturers. At the time of his promotion he was executive vice-president and head of the Building Products Division.

A. Roger Kelly, formerly a partner in Seelye, Stevenson, Value & Knecht, New York City, has been appointed an associate and manager of the New York office of Fred S. Dubin Associates. For over 15 years, Mr. Kelly has exercised primary technical engineering and management responsibility over many projects here and abroad.

Harold N. Cummings, vice-president emeritus of the Newark College of Engineering, received the honorary degree of master of engineering education at a special convocation held in conjunction with the College's 75th anniversary celebration. Since his retirement in 1950, after 30 years as a member of the faculty, Professor Cummings has been a consultant in the engineering structures section of the Curtiss-Wright Corporation, at Caldwell, N. J.

Newly elected officers of Layne & Bowler, Inc., Memphis, Tenn., Frank T. Quinn (left), president, and John M. Proos, chairman of the board, receive news of their election at a recent board meeting. Mr. Proos, in addition, will remain as vice-president of the Layne-Northern Company, Inc., which is an associate company of Layne & Bowler, Inc.

H. Kent Preston has been appointed chief product engineer of the Construction Materials Division of John R. Roebling's Sons Division, the Colorado Fuel & Iron Corporation, Trenton, N. J. He joined the John A. Roebling's Sons Corporation in 1941 as a project engineer in the Bridge Division. An authority on prestressed concrete, Mr. Preston has been instrumental in developing an economically feasible method of prestressing concrete in the United States. He is author of a recent book, "Practical Prestressed Concrete."

R. D. Thomas, Sr. and **F. L. Plummer** were made honorary members of the American Welding Society at its 41st annual meeting "in recognition of their exceptional accomplishments in the development of the welding art." Mr. Plummer, currently national secretary of the AWS, has also served the Welding Society as president. Mr. Thomas, chairman of the board of the Arcos Corporation, has been associated with the welding industry for more than 40 years.

C. F. Friedgen, after 27 years with E. I. duPont de Nemours & Company, Wilmington, Del., retired recently as architectural and civil engineer. During this long period Mr. Friedgen worked on the design of industrial projects in the United States and South America and atomic energy and government munition plants.

N. G. Dracos announces the formation of N. G. Dracos Associates, specialists in structural and soil engineering. The firm will maintain offices at 72 S.E. Second Street, Orchid Square, Boca Raton, Fla.

Floyd E. Le Van, an authority on plant site selection and senior consulting engineer in DuPont's Engineering Department, retired from the company in April after a 30-year career. Since 1947, with the exception of two years as design project manager for service buildings at the Savannah River Atomic Energy Plant, Mr. Le Van has devoted his time almost exclusively to site selection activities here and abroad.

Charles M. Bingham has been elected vice-president of the Capitol Engineering Corporation, Dillsburg, Pa. Mr. Bingham has been with the firm since 1951, most recently as chief engineer of the Highways and Airfields Divisions. He has also served as project engineer in charge of design for sections of the Connecticut Turnpike, Ohio Freeway, West Virginia Turnpike, and the Delaware Valley Extension of the Pennsylvania Turnpike.

(Continued on page 26)

HOW TO HANDLE
WET JOBS

#55 of a Series

DRY 18-FT DEEP TRENCH AT 3,700-FT ELEVATION

Sanitary Sewers, El Paso, Tex.
Contr.: T.N. O'Kelley, Utility Contractors

AT THE REDUCED atmospheric pressure of ⅔-mile above sea level, any pump works at a handicap. Despite this, the contractor desired to dry an 18-ft deep trench with his Griffin Wellpoint System installed on only one side.

• Question: in coarse, water-bearing sand near the Rio Grande River, with discharge lines as long as 700 ft, could such a wellpoint system achieve the necessary 18-ft lift?

• Based on previous local experience, it did not seem feasible. However, the Griffin system — *installed on one side* — successfully maintained a dry trench from the start, enabling T. N. O'Kelley to beat his 100-day time limit by 40 days.

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News of Members

(Continued from page 25)

Daniel A. Richards, Colonel, Corps of Engineers, and former Far East district engineer with headquarters in Seoul, Korea, has been assigned to the Deputy Chief of Staff for Logistics in Washington, D. C. Colonel Richards assumed his new duties about May 1.

Elmo R. Morgan recently accepted the post of vice-president-business at the University of California. Among other duties, his position involves supervision of design and construction at seven existing campuses throughout the state, plus new ones to be added. Former vice-president at the University of Utah, Mr. Morgan has recently been on leave from that institution and serving as Utah's director of highways.

Edward S. Fraser, in charge of the Chicago Bridge & Iron Company's manufacturing operations for the past six months, is taking over as company vice-president in charge of manufacturing, Chicago. Previously he served as assistant general sales manager of the company, manager of its Salt Lake City plant, and as an engineer in Chicago.

William L. Sheets, vice-president of the Stone & Webster Engineering Corporation, Boston, is the firm's new senior construction manager. Mr. Sheets has been connected with the construction firm since 1929. In his new capacity he will be responsible for the administrative direction of all its construction department activities.

Leo Weaver, for some 15 years on the staff of the U. S. Public Health Service, is the new chief of the Water Quality Section at the USPHS's Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio. His last position with the Service was in 1958 when he was chief of the Refuse Sanitation Unit of the General Engineering Program in Washington, D. C. For the past two years he has served the American Public Works Association as assistant director and director of research.

Jerry van de Erve was recently elected general chairman of the Western Snow Conference for a two-year term. He is also chairman of the Pacific Southwest Inter-Agency Committee and Department of Commerce adviser to the California-Nevada Interstate Compact Commission. Appointed editor of the *Snow Surveyors Forum* is **Jack Hannaford,** of the California Department of Water Resources, while **Wilbur Simons** of the U. S. Geological Survey, Tacoma, Wash., has been named associate editor of the Western Snow Conference annual *Proceedings*.

Frank M. Clinton, who has been with the U. S. Bureau of Reclamation for 23 years, was recently named director for Region 4 with offices in Salt Lake City. Prior to his new assignment, Mr. Clinton was director of Region 6 with headquarters at Billings, Mont.

Morris Schupack and **Charles C. Zollman,** partners in the consulting engineering firm of Schupack and Zollman, announce a change of address for their Stamford, Conn., office to 1845 Summer Street. Their Pennsylvania office remains at 11 St. Albans Circle, Newtown Square.

William J. Gross, as the new deputy Ohio state highway director in charge of acquisition of right-of-way, will be in charge of buying about $75 million worth of property for Ohio highways during the coming year. Mr. Gross was most recently State Highway Department division engineer at Bowling Green.

(Continued on page 28)

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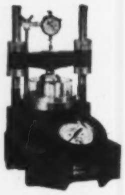

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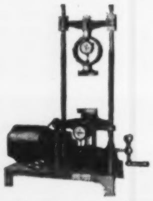

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. . . take a closer look at the Tinius Olsen line of K-W Physical Soil Testing Machines. These rugged, portable units are designed for convenient "table top" operation in the lab or on the job site.

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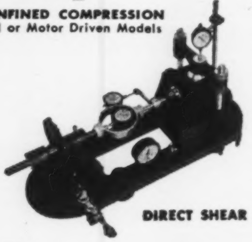
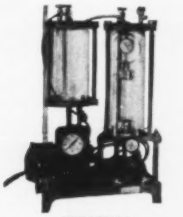


DIRECT SHEAR



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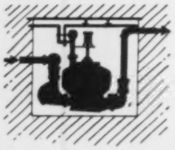

Concrete or steel underground station with Shone® Type S pneumatic ejector, mechanically controlled (warranted 25 years). Remote air supply. Nothing electrical; maintenance free, operates even under water. For municipalities and large subdivisions.

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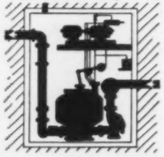
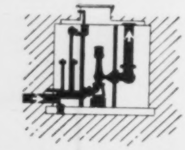


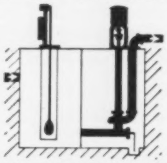
Shone® Type SAC station, underground in concrete vault. Mechanically controlled ejector (warranted 25 years) has its own compressor. Frequently less costly than package stations. Finds use everywhere.

PACKAGE STATION



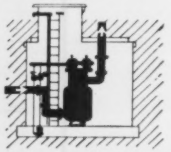
Quality underground station with vertical, short-coupled (Series 6260), dry pit centrifugal pumps. Quality design and equipment give good service life at nominal cost. For small permanent stations, growing areas.

LOW FIRST COST—EASY INSTALLATION



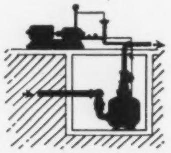
Two-compartment steel basin with centrifugal vertical wet pit pump. Pumps are not submerged; motors protected from flooding. Low first cost; fast installation. For buildings, small growing subdivisions.

ULTIMATE IN PACKAGE DESIGN



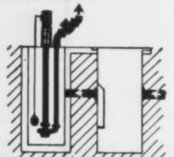
Package underground station with Expelsor® pneumatic ejector, electrode controlled. Sanitary and dependable, low maintenance, easy to service. Recommended for municipal and subdivision applications.

BUILDING TYPE STATION



Expelsor® pneumatic ejector station designed for use in buildings. Compressor is on basement floor; ejector on floor below. Sealed installation gives safe, odorless handling of sewage indoors.

SPECIAL PROBLEMS?



Centrifugal vertical wet pit pumps with adjoining settling basin. Good for areas where sand or old sewers create problems. Special pump construction for abrasive or corrosive conditions, industrial wastes.

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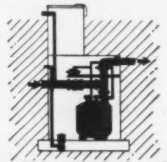

Package underground station. Expelsor® pneumatic ejector has two compartments, duplex compressors and controls. Excellent service accessibility. Especially suited for subdivision and municipal lift stations.

The answer depends on the job. Is it to be a temporary station? What about future loads? How much maintenance will it get? What type of power is available? These and many other questions must be weighed carefully and without bias. In making the decision, why not put Yeomans 61 years' experience (59 on underground stations alone) to work? Because Yeomans builds **the only complete line** of sewage lift stations in the industry, recommendations are **impartial** and in your best interest. Phone, wire, or write now.

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SPECIALISTS IN SEWAGE LIFT STATIONS—THE COMPLETE LINE

News of Members

(Continued from page 26)

Ben Moreell, Admiral, Civil Engineer Corps, U. S. Navy (Retired), and former chief of the Navy Bureau of Yards and Docks, has been elected a director of Baltimore Contractors, Inc. Admiral Moreell organized and directed the operations of the Navy's famed Construction Battalions, the Sea Bees, during the war. In 1947, shortly after retiring from the Navy, he became chairman of the board, president and chief executive officer of the Jones & Laughlin Steel Corporation. He is an Honorary Member of ASCE.

John P. Riley, until recently vice-president and chief engineer of the Ibec Housing Corporation, New York City, has been appointed vice-president for development at Lockwood, Kessler & Bartlett, Inc., general consulting engineers, of Syosset, N. Y.

Earl H. Moser, Jr., has received the "Superior Civilian Service Award," the highest civilian award granted by the Navy's Bureau of Yards and Docks "for exceptional achievements and outstanding contributions in the field of polar operations." Currently, polar division director of the Naval Civil Engineering Laboratory at Port Hueneme, Calif., Mr. Moser receives the citation for pioneer work with Operation Hardtop in Greenland, Operation Deep Freeze in the Antarctic, snow compaction research and testing at Point Barrow, Alaska, and at Squaw Valley, Calif.

James E. Stallmeyer, associate professor, **J. L. Merritt,** assistant professor, and **Steven J. Fenves,** instructor, in the University of Illinois Department of Civil Engineering, have been selected as the 1960 winners of the A. Epstein Memorial Award. Funds for the memorial award were contributed by Raymond and Sidney Epstein, of the consulting engineering firm, A. Epstein and Sons, Inc., Chicago, in memory of their father who died in December 1958. The cash awards are made to outstanding young staff members.

Carl B. Jansen, since 1946 president of the Dravo Corporation, was recently elected chairman of the board. Mr. Jansen began his business career with the Pittsburgh firm as a field engineer in 1922.

James L. Sherard, partner, Woodward-Clyde-Sherard and Associates, consulting soil engineers, New York, recently gave a four-week lecture series at the University of California, covering the practical aspects of the design and construction of earth dams. In addition to graduate students and faculty members, the lectures were attended by approximately 70 practicing engineers in the San Francisco Bay area.

(Continued on page 126)

. . . . . Am-Soc Briefs

▶ ▶ Have you done your share for the UEC? This is a timely question in these final months of the ASCE drive for funds for the United Engineering Center. Though the Society's allotted share is 94 percent completed, progress in the drive has not been at the hoped-for rate that would have permitted closing the campaign in June. . . . "Have I done my share for the UEC?"—that is the question that two out of three ASCE members must still ask themselves. . . . More about the campaign on page 46.

▶ ▶ One world through engineering. . . . The possibility of achieving a better understanding among the nations of the world through engineering was the theme of President Frank Marston's address at Massena, N. Y., on May 19 when he awarded a plaque, on behalf of ASCE, to the St. Lawrence power and seaway project as the outstanding Civil Engineering Achievement of the Year.

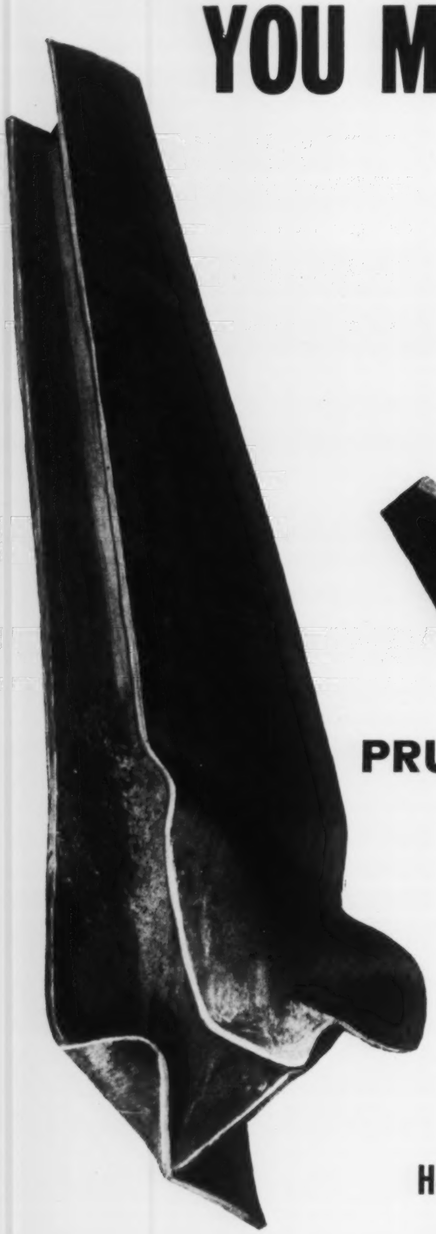
▶ ▶ In the meantime in the interest of breaking down barriers in engineering education, Executive Secretary William H. Wisely is in Europe as a member of the working team getting ready for the forthcoming meeting of the Conference of Engineering Societies of Western Europe and the United States (EUSEC), to be held in Brussels, August 29-September 3. As current general secretary of EUSEC, Mr. Wisely will attend the Brussels meeting, which will be devoted to a twenty-country comparative study of engineering education, financed by a grant from the Ford Foundation and the Office of European Economic Cooperation.

▶ ▶ On the home front. . . . An important study of U.S. civil engineering curricula—co-sponsored by ASCE and the American Society for Engineering Education under a National Science Foundation grant—will result in a culminating conference at the University of Michigan, July 6-8. Some revolutionary curricula changes may come out of this conference, which will be the mecca of engineering educators from all over the country. . . . The program is in ASCE News.

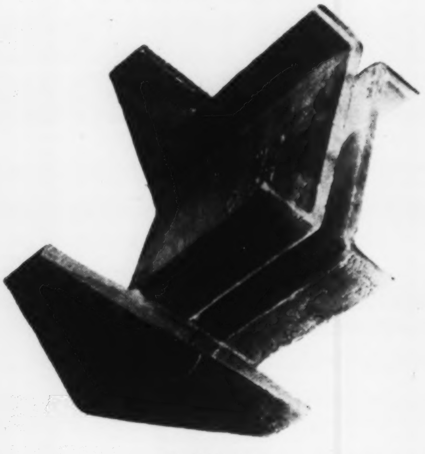
▶ ▶ The Association of Professional Photogrammetrists has acted to adopt a rigid policy among its members that would preclude competitive bidding for survey and mapping services. This action is in accord with the Society's position regarding negotiation for all professional engineering services, including surveying. The APP is to be commended for its positive assistance in advancing sound ethical principles in the practice of civil engineering.

▶ ▶ In the interests of simplicity, "Civil Engineering" has dropped volume page numbering. . . . Future indexes will identify references by month as well as page.

WHEN YOU CAN'T INSPECT—
YOU MUST PROTECT



DON'T GAMBLE



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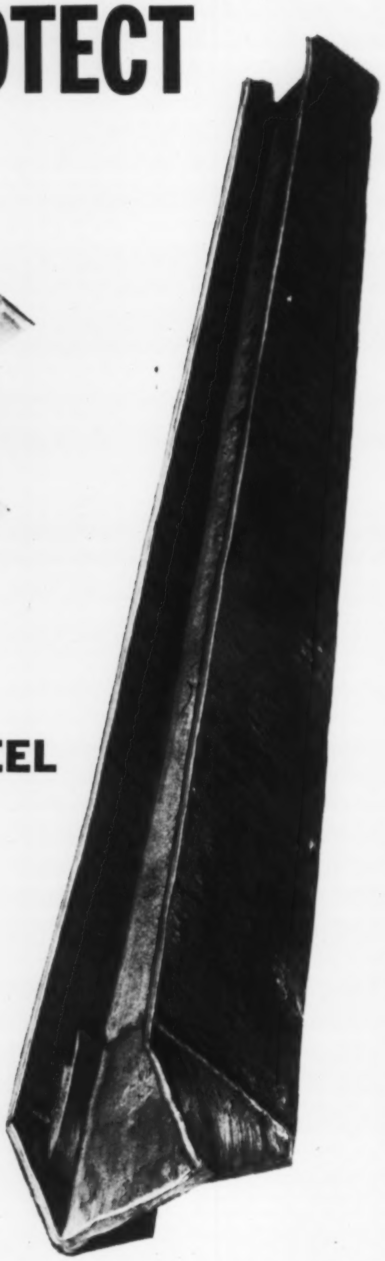
BP 75,000



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do you know that

An inventory of the nation's water needs will be made in 1960? To help keep the delicate balance between supply and demand, which is jeopardized as demands increase, the U.S. Geological Survey is starting a check of water assets and use. The proposed report will be ready by the end of 1962. The last report on the subject—U.S. Geological Survey Circular 398—revealed that the national use of water in 1955 averaged 240 billion gallons a day, the equivalent of about 1,500 gallons per person.

■ ■ ■

Steel output in the first four months of 1960 broke all records? Steelmaking furnaces in the U.S. poured a record 44,511,893 tons of ingots and steel for castings during the first four months of this year. The total was nearly 3 million tons higher than the output for the corresponding months of 1959. However, the April output of 9,771,000 tons represented a sharp decline from the 11,564,683 tons made in March and the April 1959 output of over 11 million tons. Source of these figures is the American Iron and Steel Institute.

■ ■ ■

The Shippingport nuclear power plant is being operated with "minimum hazard" to public health? The Pennsylvania Sanitary Water Board has commended the Duquesne Power and Light Company, of Pittsburgh, for the low level of the radioactivity produced in operating its Shippingport plant, the first commercial nuclear power plant for the generation of electricity in the U.S. The plant, which is on the Ohio River below Pittsburgh, has been in operation since 1957.

■ ■ ■

Helicopters will soon be tried out in logging operations? If experiments planned, by a Vancouver, B.C., timber company are successful, they could revolutionize the industry by making available millions of board feet of timber now considered inaccessible. For this our thanks to the April issue of *Industrial Engineering*.

■ ■ ■

Swimming pools are enjoying a solid boom? Pools, particularly the backyard variety, have moved dramatically out of the postwar fad stage. Figures assembled for the National Swimming Pool Institute—nationwide association of the leading manufacturers—show that on January 1, 1956, there were 56,000 swimming pools in the U.S., and that just four years later the total had climbed more than 350 percent to 254,200. More time and money and more swimmers (due to G.I. and other group training programs and the rise in population) are seen as major factors in the growth of the industry.

■ ■ ■

The AGC is disputing claims of the National Association of Plumbing Contractors that separate mechanical contracts are cheaper? The full story is available from the Associated General Contractors of America, 20th and E Streets, N.W., Washington 6, D.C.

■ ■ ■

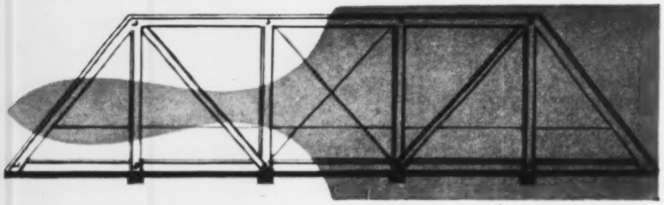
An international Space Academy will be set up? Formation of an International Academy of Astronautics has just been announced by the International Astronautical Federation and the Daniel and Florence Guggenheim Foundation, which will finance the first three years of the project. Dr. Theodore von Kármán, Honorary Member of ASCE and dean of U.S. astronautical scientists, is chairman of the Founding Committee authorized to establish the Academy at last year's London meeting of the Federation. The primary aims of the new Academy will be to provide world technical leadership for the peaceful conquering of space and to serve as a clearing house for astronautics information.

■ ■ ■

Hoover Dam marks its quarter-century of operation this year? The 726-foot-high dam, forerunner of many great projects, was started in 1931 and completed in 1935. Power generation began in 1936, two years ahead of schedule. In its quarter-century of operation, nearly a trillion gallons of water have gone over the dam—by estimate of the U.S. Department of the Interior.

■ ■ ■

Europe has serious traffic problems, too? Traffic in Rome, Paris, London, and other cities is an "unbelievable mess." This is the observation of Henry A. Barnes, Baltimore director of traffic, upon his return from a two-month inspection and lecture tour of England and the Continent, sponsored by the International Road Federation. Lack of parking control and proper street markings, plus undisciplined driving, are seen as contributing factors. Mr. Barnes' impressions of European traffic make interesting reading in *Traffic Engineering* (February 1960 issue).



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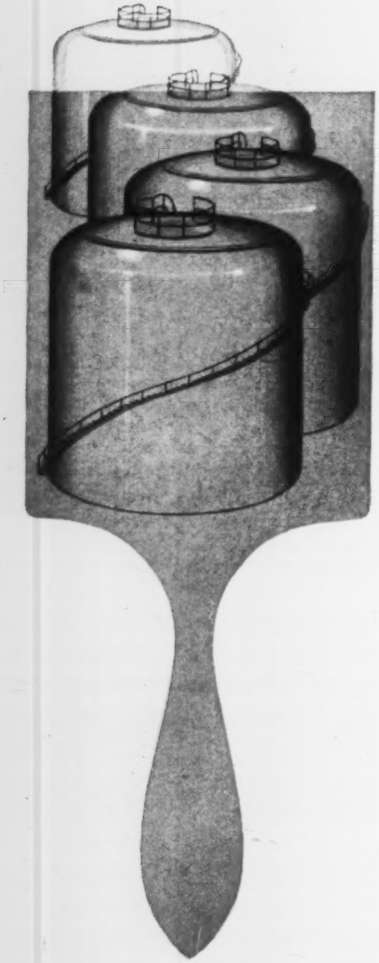

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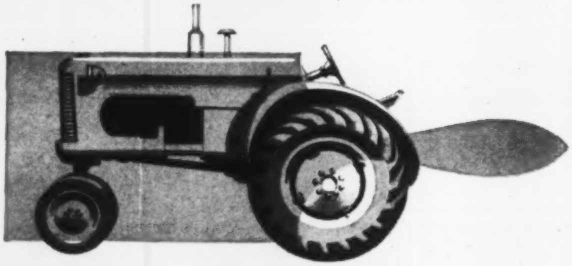

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The role of research in civil engineering

From Awards Luncheon address, ASCE New Orleans Convention

MORROUGH P. O'BRIEN, F. ASCE

Dean Emeritus, College of Engineering

University of California, Berkeley, Calif.

■ RESEARCH WILL NOT transform the civil engineering profession but it will alter, I believe, the tools available to the engineer and the nature of the works he builds. The practical objectives of engineering in general, and of civil engineering in particular, will persist unchanged. In the future, as now, civil engineering will cover the whole broad sweep of structures and systems, buildings, canals, harbors, dams, highways, bases on the moon or whatever other engineering works society wants and is willing to pay for.

Research is the search for the basic facts and general relationships needed for these accomplishments. It is of the utmost importance to the profession and to society that this quest for improvement be actively pursued—by laboratory experiment, by pencil-and-paper analysis, by observation of full-scale systems, and by whatever other means are appropriate.

Pure science, as the term is generally used, attempts to consider physical phenomena in *microscopic* detail. However, the problems of the real world tend to be *macroscopic*—they involve large aggregations of matter and many phenomena simultaneously. In these areas, the principles of basic science apply but quantitative application in detail frequently becomes hopelessly complicated. Even the boundary conditions become too complex for analytical statement, as an applied mathematician would put it. Nevertheless these large-scale and complex phenomena present a challenge to our understanding of nature, and many of them directly affect the health and economic welfare of mankind. This situation has stimulated the growth of derivative or applied sciences—meteorology, oceanography, geophysics, metallurgy, and many others—which seek facts and generalizations about these macroscopic phenomena.

Among the applied sciences is a body of knowledge designated in the aggregate as the engineering sciences. Thermodynamics, ceramics, fluid mechanics, electronics, metallurgy and many others are subdivisions of this field. These also are true sciences, since they deal with basic facts and generalizations; unfortunately, the standing of these branches of learning in the scientific world has suffered because they have been investigated with a view to practical application. They require the same viewpoint, the same techniques of analysis and experiment, and the same level of education and ability for success as do the so-called pure sciences; their utility should be regarded as a bonus to society and not as a mark of inferiority.

Thus far I have spoken of the physical sciences. There are also the social sciences occupying a hazy border zone around the domain of science. The subareas of this field—psychology, economics, political science, sociology, and so forth— differ in maturity as measured by their advance beyond observation and description into quantitative formulation, but they are nevertheless potentially sciences, if some of them have not already attained this status.

The social sciences are included here because they will, I believe, play an increasingly important role in the practice of civil engineering, a role so important that some aspects of social science might well be included within the broad designation of engineering science. Engineers cannot ignore the social, political, and economic environment in which they practice. Many important areas of engineering research will offer an opportunity for teamwork in research between engineers and social scientists. The civil engineers have potentially the greatest opportunity in this respect.

The social responsibilities of the civil engineer must increase steadily in importance if the profession is to meet the challenge of the future. For example, many observers rate the process of urbanization as the source of the most urgent non-military problems of the next decades. The engineers who design the transportation systems of metropolitan areas are in effect the principal planners of these areas regardless of what their official responsibilities may be. After freeways have permitted "suburban sprawl," a host of other requirements come crowding in—water supply, sewerage, flood control, zoning, and others in which the civil engineer should be qualified to guide toward a solution.

The civil engineer should be best qualified to visualize, and to plan for, the overall physical problems of metropolitan areas, but to be effective in this work he must understand, and consider in his plans, the social, economic, and political aspects. These considerations will be as cogent as the strictly engineering considerations in shaping the plans finally adopted.

Civil engineering is a permanent branch of the engineering profession. Unlike some other branches, which are ephemeral because they deal with narrow aspects of technology, the branch that deals with fixed structures will continue as long as man continues on this earth—and each major structure is unique to some degree. It is a safe prediction that the engineering of fixed structures—and the related analysis and design of systems—is here to stay. Civil engineering may not be as glamorous as the engineering associated with the "buzz words" of our time—electronics, jet propulsion, atomic power, space travel—but these fields also have the characteristic of passing rapidly from novelty to maturity; the obsolescence of engineers connected with them is correspondingly rapid.

Materials and structural analysis

Within the broad scope of the sciences basic to civil engineering, many areas invite research. From the developing broad scientific base in the physics of solids, engineering science should now seek to account for the macroscopic properties of the older materials—concrete, steel, timber—and of the newer materials—alloys, plastics, adhesives and composites. It should provide the practicing engineer with reliable data on the properties of these materials that affect design. It is time for a new look in the field of engineering materials.

In structural analysis it is also time for a reappraisal. The analytical methods of the practicing engineer represent a balance between the cost of the construction labor, of materials, the variations in the properties of materials, and the cost of engineering design. Structural mechanics, elasticity, metallurgy and related sciences have advanced in recent years so as to justify a reappraisal of the design techniques of the civil engineer.

Environmental control, in which civil engineers engage to an increasing extent, offers a tempting field for research. A sound approach to the problems of controlling the environment of large centers of population—air pollution, stream pollution, noise abatement, and so forth—requires research on biological effects, methods of control, and instrumentation. Civil engineers are in a good position to guide this type of research and to plan the application of the results achieved.

Soil mechanics, hydraulic engineering, and sanitary engineering offer many opportunities for research. The national effort here should be considerably expanded.

Wide scope for research is also offered by the expanding field of systems analysis. Frequently the structures engineers build are components in complex systems, which require analysis *as systems* in order that the constituent units may be compatible. Transportation systems—by land, sea and air—must be planned to handle the traffic flow predicted. River systems must meet many requirements simultaneously—flood flow, water supply, waste disposal, transportation, recreation. Many civil engineers are engaged in the planning, design and operation of systems for the supply of electric power.

Civil engineers have long analyzed some types of systems, such as highway traffic flow, flood routing through river channels and reservoirs, hydroelectric power development from river systems. In essence these problems are not new. What has changed is their complexity, particularly in the interrelationships that must be taken into consideration and the extreme difficulty of giving consideration to intangible benefits in optimizing the plans. To handle such problems mechanical aids and analytical techniques are available, such as digital and analog computers and the introduction of random variables. There is, I believe, a field for research in the development of analytical techniques applicable to classes of systems problems found in civil engineering practice. There is also an opportunity for engineering practice in the application of these techniques to particular situations.

Not only do the structures the civil engineer builds form parts of complex systems, but these systems in turn involve people. They cost money and require time to construct. Almost an infinity of alternatives are open to the designer as regards capacities to be provided and sequence of construction. What will the benefits be? How can the available resources be applied to realize maximum benefits? How can these benefits be assessed and expressed quantitatively? More specifically, what will be the effect of a new transportation system on the growth of a community? On the balance between urban and suburban population? On the location of industry and business centers? On the tax structure in a complex of political jurisdictions?

Many specialists besides the civil engineer will be involved in developing plans for such complex situations. But the civil engineer, as the agent who will effectuate these plans in concrete and steel, should participate effectively in striking the optimum balance between what is needed and what is physically and financially possible. To do so, the civil engineer must appreciate the importance of considerations outside his own technical and economic competence. He must be able to communicate understandingly with the other specialists involved and with the sponsors of the work, public or private.

The preceding topics are, I believe, suitable for truly basic research if pursued objectively by qualified individuals or groups. If they are examined in some detail, it becomes evident that the civil engineer alone cannot go far toward their solution. A group effort is required, involving different mixes of disciplines for each problem. But in each the civil engineer can play a major role in defining the nature of the problem, by supplying quantitative data for analysis, by guiding the program to a useful conclusion, and by interpreting the results obtained for use by practitioners. When the systems involve the behavior of human beings, as is the case in studies of traffic flow, the physiologist and the psychologist may be involved. Many problems of environmental control require the biologist and the medical scientist. To organize and guide this type of work presents an opportunity and a challenge for the civil engineer.

Where should research be done?

As for the means of carrying on research in civil engineering, I am convinced that those best qualified for such work are generally the faculty and graduate students in engineering colleges. The faculty of a modern engineering school stand, in interests and viewpoint, somewhere between the pure scientist and the practicing engineer and so should be in a position to apply the methods of the former to the problems of the latter. In the many departments of a university there will be individuals representing nearly all the disciplines essential to the solution of complex research problems. The products of research in a university are twofold, the research results themselves and the young graduates who participate in them under faculty guidance and who then go into engineering practice.

These are the conditions that make the universities potentially the most effective locations for this research. To realize this potential it will be necessary for the civil engineering faculties to formulate broad and imaginative programs which will both bring financial support and attract the active collaboration of specialists in other fields. Success in these directions will attract competent graduate students. The money is available, mainly from government agencies and private foundations. The urgent need is for imaginative programs of research.

FIRST OF A SERIES

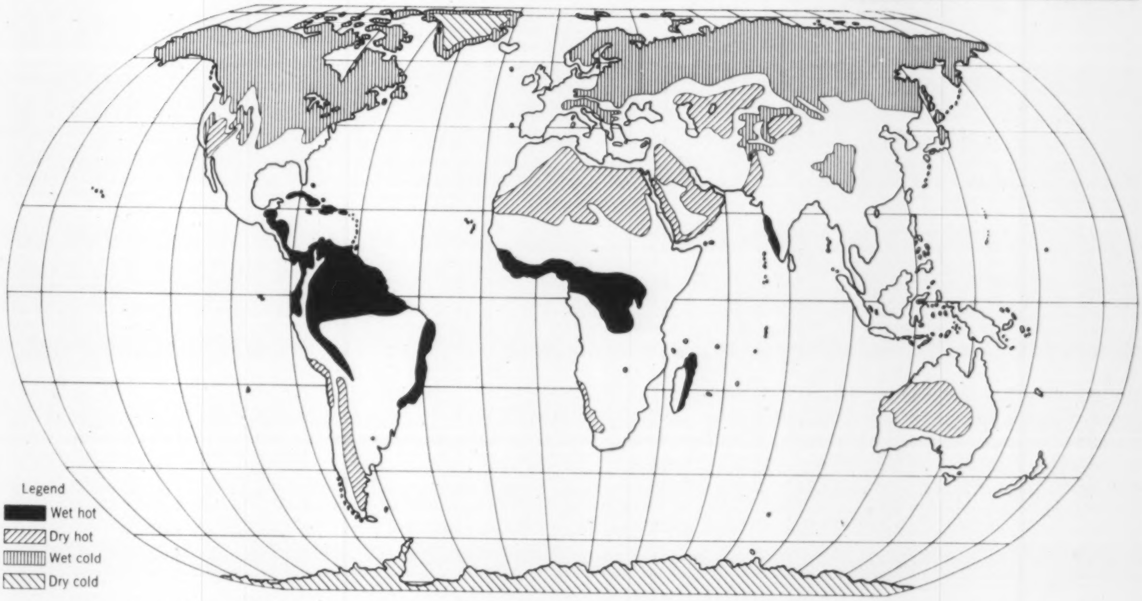


FIG. 1. Adverse weather areas of the world.

ADVERSE WEATHER—

its effect on engineering design and construction

PALMER W. ROBERTS, F. ASCE, Captain, CEC, U. S. Navy
Commanding Officer, Public Works Center, Guam, Mariana Islands

Algae and fungus growths may blacken sound concrete in two years but are damaging only to painted surfaces. Dilute acid or sodium hydroxide will clean but not prevent recurrence of growth.

Water vapor rising through a concrete slab is responsible for many failures of built-up roofs. In the Pacific it is now found best to design roof slabs with a minimum slope of ½ in. per foot and leave them bare.

Introduction: **Areas and types of adverse conditions**

Adverse weather involves abnormal conditions created by natural forces that may be detrimental to the design and construction of a project. These may be extreme conditions of wind, cold or heat, rain or snow, dryness, dust, floods or a water shortage, any of which may delay the development of a project. From the standpoint of the engineer, the adverse or extreme weather areas of the world can be identified by considering the characteristics of two extremes, those of temperature—and those of precipitation. Thus four main types of area can be distinguished—wet hot, wet cold, dry hot and dry cold—described as follows.

1. Wet Hot. These conditions occur in the tropics and semi-tropics where high humidity is accompanied by extremely rainy seasons. Temperatures vary from 75 to 100 deg F. Rainfall averages from 80 to 160 in. a year with peaks of over 30 in. a month and 2.8 in. in one hour. The annual average humidity is 80 percent. Winds are light but gusts up to 45 mph may occur. During typhoon seasons, winds of 150 mph have been recorded.

2. Wet Cold. The arctic, subarctic, and areas of continual wet snow conditions come under this head. Temperature extremes may range from −94 deg F to +100 deg F, a differential of 194 deg F in the subarctic, and also the temperature may remain below −50 deg F for almost two months at a time. Winds reach a maximum of 41 mph in the arctic and over 100 mph in the subarctic, with daily averages of 10 mph. Fog and poor visibility are prevalent in the spring and fall. The heaviest snowfall may be experienced in the foothills and mountain regions.

3. Dry Hot. These conditions are characteristic of deserts—dry, sandy and dusty. These are the sunniest parts of the earth, lying roughly between 15 and 25 deg north and south of the equator. The temperature usually rises to 120 deg F in the shade at noon and falls to 60 deg F at night. Dust storms of 15 to 20 mph are prevalent and damaging. Humidity is extremely low, rainfall meager and variable, less than 10 in. a year. There are seldom more than 30 rainy days in a year. The temperature of the soil at the surface may reach 155 deg F.

4. Dry Cold. This condition is typical of the summerless polar ice caps of the Arctic Sea, where the ice is from 8 to 200 ft thick; of Greenland, where the ice may be 7,000 ft thick; and of the Antarctic, with ice 500 to 2,000 ft thick. Here dry powdery snow and compacted ice prevail. Extreme winter winds are experienced in Greenland and in the Antarctic, where wind speeds may reach 85 to 120 mph. Often visibility may be as low as 8 to 10 ft, and in the Antarctic as much as 400,000 tons of snow may pass on a mile front during a day. Low temperature in ice cap areas may average −100 deg F, with an extreme low of —125 deg F. There is almost no rain, but fog is common in coastal areas.

Problems of adverse weather can be and are overcome through environmental engineering. This phase of engineering is concerned with the development of the most favorable living and working conditions attainable in spite of extreme conditions created by weather, terrain or a combination of both. Engineering and construction personnel are becoming thoroughly acquainted with remote areas and with what a few years back were called the last frontiers. Problems of adverse weather are to be found almost everywhere and very considerably depend on extreme elements of climate. Such factors become major considerations when dealing with engineering problems.

Most problems of environment, such as permafrost, water salinity, seasonal limitations on construction, and deterioration or corrosion of materials can be considered as problems directly relating to adverse weather. In many cases, logistics support requirements must be considered by planning, design and construction people to meet adverse weather. Generally construction materials as well as skilled labor are non-existent or in short supply in the adverse weather areas.

Four types of area where adverse weather conditions are regularly to be expected have been outlined. However, extremes can be experienced temporarily in the more temperate zones. In New York, for example, winter temperatures may remain near or below freezing for over a week; in the North Central States, zero temperatures may prevail; high winds may develop in the fall and torrential rains in the late summer. Any one of these, if unpredicted or not planned for, may require the development of new design criteria or may stop all work on a job.

It has been proved that a contractor can work at near zero F temperatures. However, such work is successful only to the degree planned for and when the proper environment for concrete pouring and curing has been provided. For those not skilled in these techniques, the Bureau of Reclamation, the Portland Cement Association, Sika Chemical Company, the Concrete Industry Board, the Army Engineers, the Bureau of Yards and Docks, U. S. Navy, and other organizations can provide excellent background data and procedures.

Seasonal extremes of high wind and rain can be planned for but call for foresight and initiative to reduce damage and resultant loss on the project to the contractor and the client. Unpredicted and unusually heavy snow, if not handled with judgment, while the storm progresses or during the hours immediately following, may prove disastrous to transportation, particularly in the case of highway and airport work.

Adverse weather speeds deterioration, that is, a loss in the value, strength or useful life of a material. The forces that tend to cause this change are agents directly related to environment. The intensity of these agents may vary with the degree of the adverse weather conditions. The primary factors in deterioration are physical and chemical agents—heat, sunlight, moisture, salts, alkalies, wind and dust. The secondary factors are biological agents—fungi (molds), bacteria, insects, termites, and marine organisms.

Car mufflers or window closures on residences that last two or more years in New York may fail completely in four months on Kwajalein, a hot humid climate where salt-laden winds cross the island. An untreated fence-

Editor's Note: Captain Roberts has made an exhaustive study of adverse weather as it affects the design and construction of projects of the U. S. Navy from the tropics to both poles. As an avocation he has collected data from all over the world on engineering and construction under the worst conditions of temperature, wind and water. In a series of articles in Civil Engineering he tells how many of the problems of adverse weather can be met. An introduction sets the locale for several types of weather conditions. Design and construction to meet "wet hot" conditions are also discussed in this issue.

post remains free of rot on the great American desert, but the same post soon becomes a part of the soil in a Central American jungle, through the rotting action of microorganisms thriving in the ground. A thorough knowledge of the relationship between the deterioration of materials and extreme climatic conditions is of the greatest importance in a study of the effects of adverse weather.

Local materials

It has long been the practice of U. S. engineers and contractors to rely on U. S. materials, equipment, methods and labor. During World War II, when transportation was taxed to the utmost, and the lengthening list of critical materials precluded sole reliance on home products, new sources were developed overseas. Since that time, the tendency has been to attempt to utilize or to encourage the development of timber, cement, tools and equipment sources and capabilities, as well as the indigenous labor of the country or locale where the work is to be carried out. The advent of NATO, of SEATO, as well as other security and mutual assistance pacts, has further stressed the importance of using local materials and developing skills among indigenous personnel. These factors are important in areas of adverse weather.

There is a great need for gathering information on how to get the most done on a job in spite of extreme weather conditions, on specific problems and situations, on criteria and methods, and on means of making such information available to those in the engineering and construction fields. Some of this work has been done through the efforts of the national building research boards of Canada, England, Australia and the United States and by the Corps of Engineers, U. S. Army, and the Bureau of Yards and Docks, U. S. Navy.

You can help

How can the task best be accomplished? As a start the Construction Division of the ASCE has formed a Committee on Adverse Weather Conditions with subcommittees for each of the four conditions or areas that have been here outlined. This group is gathering data, problems, solutions, and ideas generally. The assistance of every Local Section of ASCE has been requested. Individuals are invited to contribute data by addressing the writer, who is chairman of the committee, at Navy 926, Box 193, FPO, San Francisco, Calif. The value of such information to engineers who must work under adverse weather conditions will be inestimable.

1. Humid tropic areas: Wet hot conditions

Wet hot conditions may be found in such places as Central America, along the equator in South America, in Central Africa, Malay, the Philippines, Kwajalein and Guam. This is a wide area in which conditions vary to a greater or less degree at each location depending on the combination of sun, temperature, moisture and wind as well as chemical and biological agents.

1. High annual rainfall of 75 in. or more may not be a problem except when the rainfall is extremely high during a few months of rainy season. This is the case at Subic Bay in the Philippines from June through September, or on Guam or Kwajalein from July through November. The destructive action of heavy rainfall—over 16 in. in one month—undermines roads, erodes slopes, and causes major faults to develop, with the result that tons of soft material slide down into valleys and onto highways.

Under such conditions, underdesigned culverts and inadequate drainage channels become a major problem. During a rain storm of over 3 in. in one hour, one end of an airfield became badly flooded. The solution to this problem was to drill holes of 24-in. diameter into existing subsurface caverns in the native coral bedrock. Vertical pipes were installed and the flooding relieved through the use of these subterranean channels as drains for the excessive runoff.

2. Heat as an obstacle was encountered during the construction of the Kariba Dam on the Zambese River in Rhodesia. In this low and humid area, water drawn from a cold-water faucet had a temperature of 102 deg F. Workers found it necessary to carry their tools in water-filled buckets to protect them from the hot African sun. Salt tablets were required in large quantities.

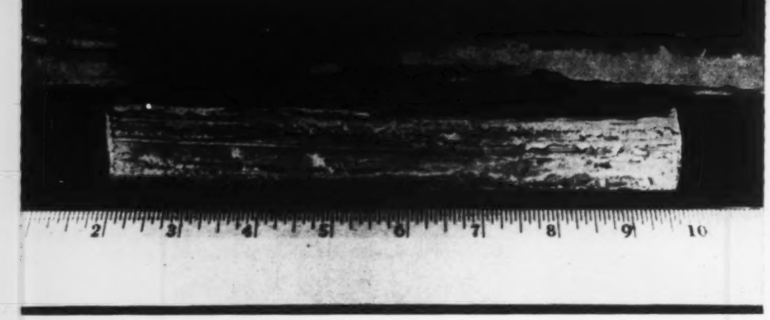
3. Poor weather data and freakish extremes often result in underdesign. The Kariba Dam was designed for a river flow of 224,000 cfs, 10 percent above the highest flood level recorded in fifty years. Yet, during the three years of its construction, the flow reached 240,000, 290,000, and then 575,000 cfs, an increase of 182 percent over previous records. Construction facilities were damaged or lost as a result.

4. Disease may be an enemy. The organisms causing sleeping sickness and malaria, carried by the tsetse fly and the anopheles mosquito respectively, can be almost eliminated by the adoption of strict controls and spraying measures. Most insects are not disease carriers but many create a nuisance that greatly reduces the effectiveness of skilled labor.

5. Destructive action of climate on materials in most cases is due to the presence of water. The primary effect of high temperature on building materials is dimensional movement and cracking. The penetration of moisture through exposed concrete and other cementacious walls can be a major cause of difficulty. Surface molds develop in the small capillaries, resulting in disfigurement of paint, unsightly staining and mild surface etching. In many cases, however, this does not affect the durability of the structure.

The deterioration of materials in hot humid areas is greater than in most other areas. This is due to the combination of high temperature, high humidity, drenching dews and radiation. On islands, salt laden winds, high soil

Rainfall in some areas, averaging more than 30 in. in some months, undermines roads and erodes slopes.



Galvanic corrosion of underground telephone cable has been partially alleviated by cathodic means.

resistivity and soil conditions intensify the problem. These conditions are in contrast to those found in hot desert areas where the air is dry, and little corrosion takes place.

Examples of deterioration of materials

Galvanic corrosion of underground power and telephone cables is a problem on Guam. This difficulty is greatly reduced by the installation of anodes and rectifiers, the removal of pull wires in vacant ducts, and the use of bonding to existing cathodically protected petroleum pipelines.

All timber products must be either Wolmanized or treated with pentachlorophenol where above ground, and must be treated with vacuum pressurized creosote where below ground. Termites are probably the most destructive agent attacking timber and cellulose products. If all lumber, as well as the soil under a structure, is not properly treated, insect damage can occur in less than a year.

Paint performance is generally poor, usually because of weathering, attacks by fungus or by algae. Paints with oil, varnish or emulsion bases are satisfactory on dry wood surfaces but have proven unsatisfactory on masonry regardless of surface preparation. Interior and exterior paints with a rubber base have proven generally acceptable for masonry walls.

Metal shapes and sheets require careful selection and in many cases constant maintenance. For example, structural steel requires frequent painting, and steel columns embedded in concrete require a coal-tar enamel covering to a point 6 in. above the concrete surface. Partly embedded steel, such as railings and anchor bolts, should be galvanized. Galvanized sheet steel requires a protective coating.

Aluminum sheets—type 3003 and 5052-H34, 20 gage—have proved most suitable for exterior siding. Non-copper-bearing aluminum alloys and stainless steel with a high nickel content—type 316 or 317—are the most satisfactory materials for flashing, gutters and downspouts. Copper flashing has proved unsatisfactory. Stainless steel—types 316 and 317—is the most satisfactory material for door and window hardware.

6. Non-availability of familiar materials is a problem that must be fully understood. In many cases products available locally can be substituted to advantage. As an example, timber such as Douglas fire or southern pine is specified for power transmission poles and white or red oak for waterfront construction. In the far Pacific, apitong timber from the Philippines can be used in either case at appreciable savings. In a recent study made on the Island of Guam it was found that poles 50 ft long with a 16-in. butt, delivered on Guam, would cost as follows:

MATERIAL	LENGTH OF LIFE	COST PER POLE
Steel, tubular	30 years	$499
Concrete	30 years	295
Fiberglass	(?) years	206
Southern pine (creosoted)	20 years	171
Douglas fir (creosoted)	15 years	160
Apitong (creosoted)	30 years	105

Hardwoods are fairly abundant throughout the world and can be used to advantage in waterfront construction. Local timber having the needed bonding strength, hardness, shock resistance, weight, durability and resistance to attack by marine borers is available throughout the world.

Special problems with concrete

Unless special care is exercised, concrete will have low strength and high porosity; the latter will permit moisture to reach and corrode reinforcing, with resulting spalling. Most problems of poor concrete have to do with cement storage and handling methods, poor selection and control of aggregates, the incorrect installation of reinforcing steel, or the improper proportioning and curing of the concrete.

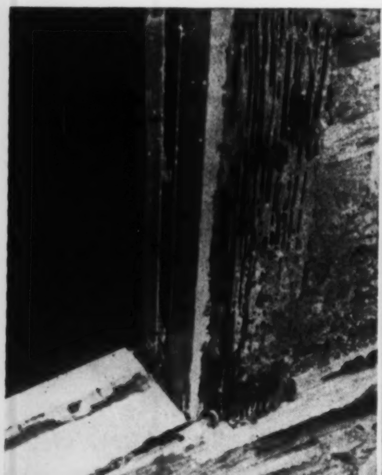
In areas where coral aggregates are used, grading deficiencies are encountered but can be corrected. Free moisture varies as much as 10 percent in any 15-min interval because of high humidity, intermittent showers and solar heat. In the islands of the mid and far Pacific, the following general difficulties have been encountered in connection with concrete structures:

Cracking. The most prevalent type of deterioration is cracking, believed to be the result of a high rate of shrinkage due to rapid drying of the surface. An excessive amount of fines or dust in the mix may be a contributing factor.

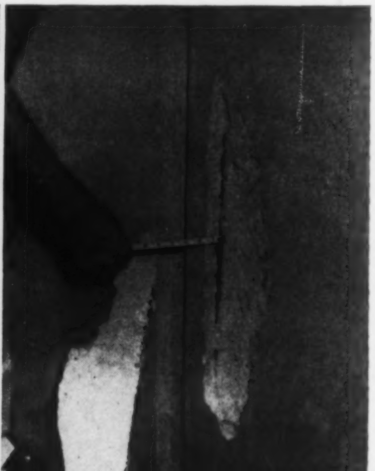
Spalling. Extensive spalling has occurred on reinforced coral concrete after it has been in place four or more years. The highly permeable honeycomb structure permits oxygen-bearing moisture to penetrate the concrete and come in contact with the steel. Corrosion of the reinforcing steel increases its diameter and causes the surface concrete or cover to pop off or spall. Poor workmanship and inadequate inspection are partial causes.

Spalling may reach serious proportions in cases where coral aggregate concrete has been made with water of high salt content. A 15-year-old multistory building in Bermuda deteriorat-

To prevent termite attack, most wood must be treated with pentachlorophenol or Wollmanized for above-ground use and pressure-creosoted for below-ground use.



Spalling of concrete sometimes occurs after four or more years as moisture reaches the reinforcing, which expands as a result of corrosion. A typical instance is illustrated here.



ed to the point of failure and was demolished because the concrete broke away from the reinforcement so that there was no bond or strength.

Spalling is seldom found where the concrete cover is 2 in. thick or more. When spalling has occurred, corrective measures are necessary and they are expensive. Costs may vary from $1.25 to $3.00 per ft.

Vertical and horizontal surface cracking of concrete-block structures. Where surface cracking develops in the walls of concrete-block buildings, the cause has been traced to several factors other than foundation settlement. Three of these are:

1. Because of differential shrinkage, long concrete roof slabs, constructed without a deep edge rib, sag in the center and rise off of their supports at the corners. The presence of reinforcing in the bottom of the slab increases this effect. As the edge of the slab curls, a part of the masonry wall may remain attached to it and so may be lifted by it, causing cracks in the walls. This danger can be lessened by the use of deep edge ribs along the slab or eliminated by the use of a concrete-frame structure with block curtain walls.

2. The temperature on the surface of a concrete roof may rise to 160 deg F after five or six hours of exposure to direct tropical sunlight. A long, continuous concrete-slab roof (60 ft) may be subjected to a horizontal movement of more than 0.35 in., and vertical surface cracking may result in the block wall. This condition can be eliminated by providing an expansion joint at the center of the slab.

3. In areas where seasons of high rainfall are followed by periods of little or no rainfall, foundation troubles may arise. These are due to swelling in hard colloidal confined clays, where changes in moisture content result in the development of enormous pressures—up to 12,000 lb per sq ft. In masonry buildings the result is surface cracking at the corners of windows or along grade beams. The solution to this problem is to carry the footings below the line of seasonal moisture changes.

Excessive efflorescence may be a problem. Where exterior or interior concrete surfaces require painting, strict inspection of curing is necessary. Walls not properly cured require treatment with a solution of phosphoric acid and zinc chloride before they are painted.

Fungus and algae grow rapidly in hot, humid climates. Concrete and masonry structures that are essentially sound show surface staining and blackening caused by the growth of fungus or green algae after little more than two years of exposure. This condition is unsightly but not damaging except to painted surfaces. Cleaning may be done with a dilute acid or sodium hydroxide solution. No permanent answer to this problem has been found.

Failure of roof coverings on concrete roofs has been under study for many years. Four-ply built-up asphalt surfacing, when applied with either a bituminous or a gravel finish, is generally considered the most satisfactory for concrete roofs. Such roofs, of a design to give a 15- to 20-year life in temperate areas, fail in from 2 to 6 years even when carefully placed. This failure is usually caused by water vapor that has passed through the porous concrete slab and formed blisters in the asphalt roof covering.

Best results can be obtained by allowing the top of the slab to dry thoroughly before the cover material is applied, and by coating the under side of the slab, in dry weather, with an organic water-vapor barrier. Crushed gravel used for coatings should be washed to remove fines and insure embedment and adhesion. Roofing should not be applied when the weather is damp or rainy.

Because of the difficulties encountered with roof coverings over the past ten years in the islands of the Pacific, it is now considered most satisfactory for concrete roofs that show no cracking to be left bare. In such cases the mixing, broom finishing and curing of the concrete must be carefully controlled. A minimum slope of ½ in. to the foot must be provided for rapid runoff, and adequate expansion-joint materials must be used.

Cement asbestos is generally considered suitable for roofing in wet humid areas if a minimum roof pitch of 4 in. per ft is specified. Sealed joints with double overlap should be provided to reduce moisture penetration during prolonged rains.

General comments

In hot wet areas, as in cold areas, there are times when only limited work can be done. For example, at Subic Bay in the Philippines, rainfall in August reaches a peak of 38 in. in one week. The rainy season runs from June through September. Winds over 40 mph occur in October, and a typhoon to the south may create high seas, limiting operations on water including dredging and delivery of supplies. Normally all types of construction can be conducted successfully from October through May. The period from June through September can be used for inside building work and equipment maintenance.

Finally, housing in the tropics must provide for three kinds of living areas —indoor, indoor-outdoor, and outdoor. Full advantage must be taken of natural ventilation and prevailing winds while at the same time the living area is protected against the glare of the sun and heavy rains. These objectives are attained by orientation of buildings, by open construction that utilizes jalousies or louvers, and by use of overhanging roofs, verandas and lanais or patios.

(This article was originally presented by Captain Roberts before a January 1960 meeting of the ASCE Metropolitan Section in New York. How to work under the adverse weather conditions of wet cold will be discussed by him in the next issue of Civil Engineering.*)*

HOW HARDWOOD QUALITIES COMPARE—a partial check list

Region	Name	Bending Strength	Hardness	Shock Resistance	Specific Gravity	Durability	Marine Border Resistance	Availability
No. America	White Oak	Fair	Fair	Good	0.68	Must be creosoted	Good treated	Abundant
British Guiana	Greenheart	Very strong	Very hard	Good	0.93	Excellent	Excellent	Abundant
Brazil	Piquia	Strong	Hard	Good	0.88	Good	Fair	?
So. America	Acapu	Strong	Hard	Good	0.95	Good	Good	Fair
Western Pacific Region	Bogoia	Strong	Hard	Good	1.14	Good	Very good	Plentiful
Phil. Islands	Apitong	Strong	Hard	Good	0.80	Creosoting recommended		Plentiful
Phil. Islands and N. Guinea	Narig	Very strong	Very hard	Good	0.97	Good	Very good	Fair
New Britain and Moluccas	Zizanu	Good	Hard	Good	0.75	Good	Good	Plentiful
So. Papua	Paper-bark	Strong	Very hard	Fair	...	Good	Good	Abundant
So. China Sea Region	Bakau-belukap	Strong	Hard	Good	0.99	Durable	Good	Plentiful
Thailand and Burma	Teng	Strong	Hard	Good	1.04	Good	Good	Plentiful
Burma	Pyinkado	Strong	Hard	Good	0.95	Very durable	Good	Abundant
E. Pakistan	Nageswar	Very strong	Very hard	Good	1.02	Very durable	Good	Fair
West Africa	Ekki	Very strong	Very hard	Good	0.97	Very durable	Very good	Plentiful
Australia	Ironbark	Very strong	Very hard	Good	1.10	Very durable	Good	Plentiful

How to get quality concrete . . . .

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Concrete as a construction material deserves the same degree of knowledge and operating know-how in its manufacture as are now applied to other basic materials used in construction, such as steel, glass and all the other elements that go into present building operations.

That concrete in the past has not received the same technical consideration and care is attributable to the ease with which something resembling concrete can be produced by any layman. He need only provide himself with a sack of cement and mix with it common ingredients found anywhere around him, such as sand, stone and water. The general use of cement in this manner, and the general acceptance of the name "concrete" for the finished product, has built up this concept of concrete in the minds of the public. But it in no way represents or approaches the product that can be produced by technical skill and construction know-how.

In no other industry in existence do the essential component parts operate more independently of one another than in the concrete industry. A large percentage of those engaged in some phase of the industry do not realize that the production of quality concrete is a highly technical procedure to which, because of its nature and application in a finished structure, should be given even greater technical control and surveillance than is given to other materials, structural steel for instance.

It is up to those who appreciate the problem to devote every effort, by education and otherwise, to promote in all phases of the industry a full realization of the necessity for adequate control of concrete in its production, in its placement, and in its curing. Each of these must of necessity be performed in accordance with recognized technical procedures before a satisfactory finished product can be obtained.

An example of existing conditions is the case where an accumulation of water on the slabs of a reinforced concrete structure indicated excessive deflection soon after construction and before any load was applied. Efforts to obtain details as to the adequacy of forms, dates of placing and stripping, delivery tickets indicating the make-up of the concrete, and the like were not very successful. The contractor disclaimed all responsibility, stating that he followed the plans and specifications exactly. An engineering opinion obtained by the contractor was that the design was deficient. The owner thereupon called on the architect and the engineer, claiming that it was their responsibility, and directed them to take the necessary corrective measures.

There naturally followed a prolonged discussion among the contractor, the structural engineer and the architect. It was possible to proceed with the work only under a compromise agreement, that the cost of the corrective measures would be divided equally among them. By this means no one accepted the responsibility. The condition ultimately was corrected at increased cost to the engineer, the architect and the contractor, and delay to the owner. This turned a good job into a sour one for all concerned.

Subsequent investigation revealed that there was less cement in the concrete than the specifications required. It was apparent that there had been gross misjudgment in determining the time for the stripping of forms.

Passing the buck

When difficulties arise in the construction of a concrete structure, it is practically impossible to place the responsibility where it belongs. The ready-mix man blames the testing laboratory; the laboratory blames the contractor; the contractor blames the design. There is a complete circle of blame, with no stopping point.

It does little good to employ a general contractor of fine reputation and character, only to have his work vitiated by a careless concrete subcontractor, or for a good subcontractor to procure his ready-mixed concrete from a careless, unreliable source.

It makes no difference to the owner of the structure which branch of the industry has fallen down. All he knows is that he has a concrete structure that is unsatisfactory and he condemns concrete in general.

A few years ago one of the public agencies of the City of New York was considering restricting the use of concrete for the structural frames of multistory buildings, because of the lack of uniformity in the quality obtained. The result of such an edict would have been a serious blow to the concrete industry in the area. To forestall such a restriction a group of prominent members of the industry took action.

There exists in New York an organization known as the Building Trades Employers' Association, organized primarily to handle wage negotiations, union relationships, job conditions, fringe benefits, etc. One important adjunct of the BTEA is known as the Cement League, the membership of which includes a majority of the concrete contractors. A group of its members, sponsored by the League, was organized for the purpose of correcting the conditions concerning concrete that disturbed the public agencies.

There are few complaints about the theory and design of structural concrete. The research institutions, the American Society of Civil Engineers and the American Concrete Institute, are providing adequate technical skill in the preparation of designs and specifications. The function of the new group was to see that the concrete, starting with the production and the mixing of the ingredients, received proper care and handling, proper placing in the forms and proper curing, so that the finished product would in fact reflect the true concept of the designer.

To assure quality concrete it was necessary that the group include a representative of every component of the producing industry so that by pooling of interest, by the recognition of the common problem, by intermingling and by open and frank discussion, each would accept responsibility for the proper performance of his own particular function. Thus no one member would jeopardize the end result of the entire group.

In accord with this basic concept and organizational set-up, the group, which calls itself the Concrete Industry Board of New York, invited as members representatives of every component of the industry. Its objective is the continued production of concrete of uniform quality of the type specified for every structure.

That the group would be truly representative of the industry was assured by having each component of the industry represented on the Board of Directors. Further, the representative of a particular group on the Board is not selected by the CIB, but by the group which he represents. For example, the Metropolitan Section of the American Society of Civil Engineers nominates its representative to the Board of Directors, as do the New York Association of Consulting Engineers, the American Concrete Institute and the American Institute of Architects. Similarly the representatives of the testing laboratories, the ready-mix producers, the Concrete Reinforcing Steel Institute, and the like, are named by their respective groups.

Obviously a board so constituted cannot favor a particular group within the industry. It is a board truly representative of the entire concrete industry, whose objective is the improvement and strengthening of the industry as a whole. This is accomplished through the proper execution of the basic plans and specifications for the structure—not by developing a new theory for concrete or by changing the design.

The CIB is unique in that it gives the contractor recognized status vis-a-vis the architect, the engineer and other technical groups. Such recognition must in itself develop an increased degree of responsibility on the part of the contractor, his subcontractors and their personnel.

It is recognized that the principal means of accomplishing the purpose of the Concrete Industry Board is through education and the interchange of information. There is no enforcement authority of any kind. A forum is provided where the members can discuss their problems freely with their confreres and with members of other branches of the industry. In very few localities is there adequate coordination of effort among aggregate producers, cement manufacturers, testing laboratories, ready-mix producers, general contractors and concrete subcontractors—all vital links in the concrete production chain. Coordination is essential as failure on the part of any one of these elements to properly perform its part in the overall operation means failure of the entire operation.

Bear in mind that concrete is the only major element of most structures that is manufactured at the site. As a matter of fact, one essential part of its manufacture, that of curing, usually takes place when it is in final position in the structure.

Fortunately during this period the concrete gains strength so that construction can continue during the curing period. However, should the concrete fail to develop its design strength and should its removal become necessary, the losses are cumulative and manifold.

In the face of such dire consequences, should anyone ever hazard a failure due to poor quality of concrete? Obviously not—but there have been many errors of omission and commission resulting in such failures. This situation, being dependent on the human element, probably cannot be completely surmounted. However, it is believed that the recommendations given below, if followed, will result in the production of better concrete.

The conditions in almost any trade area can be improved by organizing and coordinating all related activities in a local concrete industry group, dedicated to the production of better concrete.

The Concrete Industry Board of New York, of 220 East 42nd Street, New York, will be glad to furnish any advice or help in the formation of a local group. The CIB has no interests beyond production of quality concrete.

Tips for better concrete

Tell the full story on difficulties and failures in handling concrete so that the technical magazines can give the valuable data to all. Such knowledge will prevent the making of the same mistakes over and over. Fewer troubles will cause buyers to be better satisfied with concrete and will keep concrete in a better competitive position.

Design the mix to meet only the strength required. Known overdesign—for example where compressive strengths of 4,000 psi are consistently reported but only 3,000 psi is required—involves extra cost. Overdesign is known to everyone involved in the project and becomes in itself an invitation to carelessness. The final result is a less dependable concrete than would have been obtained using a 3,000-psi design that everyone knows must be handled carefully to assure that specifications are met.

Use higher unit stresses for quality concrete. The good batching, mixing and placing equipment now available can consistently turn out a dependable product. Latin Americans use double our 3,500- to 4,000-psi design strengths with machines that are not so good as ours. Should we be satisfied with less?

Pay direct for testing and inspection. The client, or the engineer for the client should always pay the fees of the testing laboratory. It is now customary throughout the industry for the contractor to pay the fee of the laboratory that tests the concrete specimens. This is basically wrong! A testing laboratory may have to reject a contractor's work in the morning—and in the afternoon beg the contractor for payment on account to meet the laboratory's payroll. Will a contractor again engage a laboratory with which he has had disputes?

Have the designer supervise construction. The engineer who designs the structure should follow the construction work through to completion to ensure adequate service and protection to his client.

Heed the maxim, "Speed kills." This saying applies to concrete and should be heeded. It may take years to promote, finance, and design a project. But once it is started the builder is under terrific pressure to complete it. Many difficulties in obtaining quality concrete can be traced to unrealistic time schedules. Concrete should have the time required to make it a quality product.

Vinyl film liner for earth-fill reservoirs

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Finding an ideal liner for earth-fill reservoirs has long been a problem for engineers and advocates of water conservation. It is generally agreed that the ideal liner should be: (1) impermeable to water, (2) reasonably durable, (3) flexible over a wide range of temperature, (4) resistant to mechanical damage, weathering and deterioration, (5) low in cost, and (6) easy to install. These qualities are particularly important in the arid and semi-arid parts of the nation and are very necessary where the available earth materials are free draining.

Studies and tests conducted by several universities and by the U. S. Agricultural Research Service have shown that buried plastic film linings, particularly vinyl and polyethylene, seem to meet the requirements better than other materials. Further, it has been found that a vinyl film liner, black in color, is superior.

Recently this type of liner has been installed in a number of reservoirs. Three in the South Davis County Water Improvement District, just north of Salt Lake City, Utah, were lined with an 8-mil vinyl film in 1959. These reservoirs are part of a $634,000 pressure irrigation project begun early in 1959 with funds provided under Public Law 984, for small reclamation projects. The reservoirs have capacities of 1, 5, and 9 acre-ft and serve as equalizing storage for three separate pressure units. They provide irrigation water for 1,000 acres of land in the rolling foothills of the Wasatch Mountains.

Reservoir construction

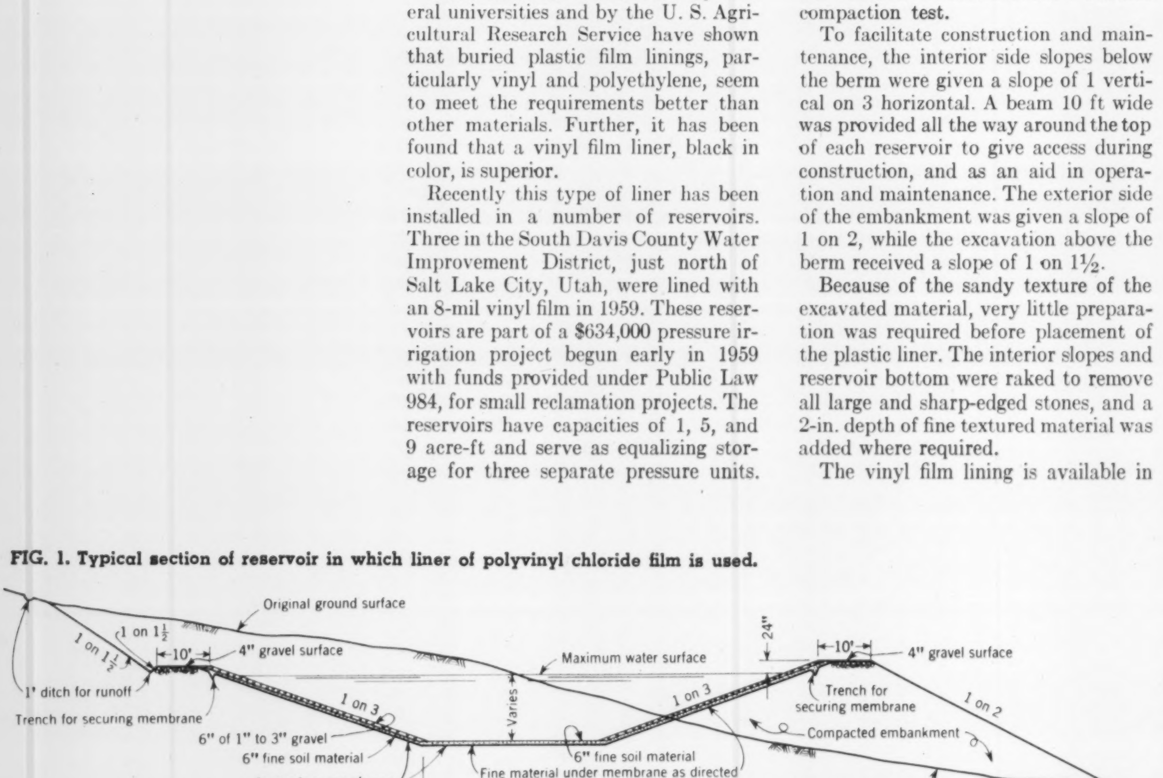
Constructed on sloping ground, the reservoirs were primarily in excavation, with a small compacted embankment on the downhill side. The excavated material was sandy, with some gravel and clay. When compacted at the optimum moisture content in 6-in. layers, all embankments exceeded the required 95 percent of the "laboratory standard maximum soil density," as measured by the Bureau of Reclamation's Proctor compaction test.

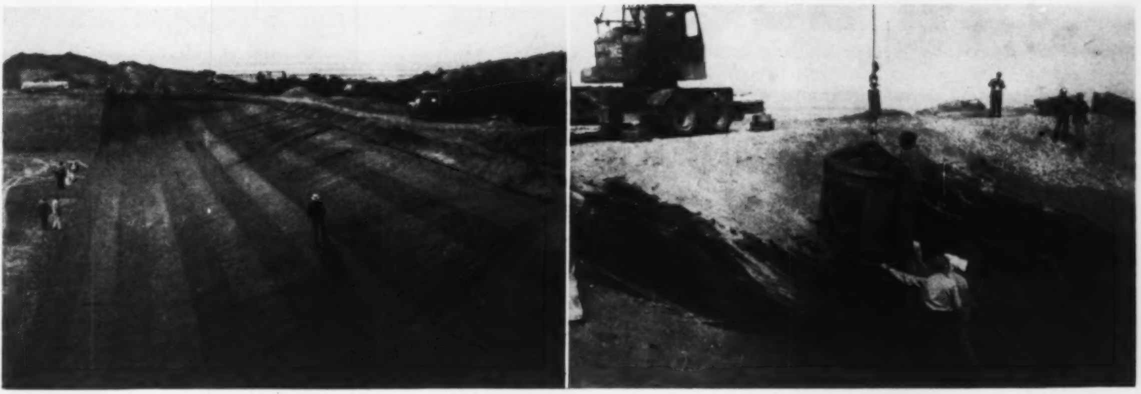
To facilitate construction and maintenance, the interior side slopes below the berm were given a slope of 1 vertical on 3 horizontal. A beam 10 ft wide was provided all the way around the top of each reservoir to give access during construction, and as an aid in operation and maintenance. The exterior side of the embankment was given a slope of 1 on 2, while the excavation above the berm received a slope of 1 on 1½.

Because of the sandy texture of the excavated material, very little preparation was required before placement of the plastic liner. The interior slopes and reservoir bottom were raked to remove all large and sharp-edged stones, and a 2-in. depth of fine textured material was added where required.

The vinyl film lining is available in

FIG. 1. Typical section of reservoir in which liner of polyvinyl chloride film is used.


Original ground surface
1 on 1½
1 on 1½
10'
4" gravel surface
1' ditch for runoff
Trench for securing membrane
1 on 3
6" of 1" to 3" gravel
6" fine soil material
Impervious membrane
Maximum water surface
Varies
Varies
6" fine soil material
Fine material under membrane as directed
1 on 3
24"
10'
4" gravel surface
Trench for securing membrane
1 on 2
Compacted embankment
Original ground surface



Above, liner of polyvinyl chloride film is being positioned in reservoir of 9-acre-ft capacity. This piece of liner is 8 mils thick and measures 56 ft by 296 ft. The bump near the top of the liner (below truck at right) indicates the location of the concrete overflow structure. The liner was cut and a watertight collar formed around this structure. The liner is held in position by an anchor trench around the top edge, as seen in Fig. 1. In covering the liner (above), fine-textured material was placed first. This material, which was obtained from the excavation, consisted of sand with some clay binder. It was placed from a concrete bucket operated by a crane with an 80-ft boom. A factory fabricated seam can be seen in the exposed liner.

widths up to 61 ft in increments of approximately 52 in. and in lengths as desired. Fabrication by solvent lap seaming was done by the Union Carbide Plastics Company. The material was supplied folded accordion-like in both directions so that it was very easily applied by a four-man crew. For the largest of the three reservoirs, four pieces were required. Three of them were 56 ft by 296 ft and the fourth was 30 ft by 296 ft. The 5-acre reservoir required four pieces each 48 ft by 186 ft, and the smallest reservoir, two pieces each 61 ft by 105 ft.

The film was installed by laying it out in the longitudinal direction first, the men standing about 20 ft apart. They wore gloves so that the liner would not be punctured by sharp fingernails. After the film was opened, it was stretched to remove wrinkles, but was allowed to relax without tension in its final position.

For sealing around connections and around inlet and outlet structures, the film was stretched over the hole, cut and rolled into a collar. Next it was nailed to a redwood strip which had been previously attached to the structure. Finally the whole area of the connection was painted with a very good mastic material. This method seemed to provide an excellent watertight connection.

For each reservoir, several field welds were required. An overlap of 6 in. at the joint was necessary and the field weld was made with adhesive supplied with the material, the adhesive being a solvent. The rate of making a seam was about 250 ft per hour for the four-man crew.

Around the top of the reservoir, above the maximum water level, the liner was buried in a 12-in. trench to prevent it from sliding down the slope. Then a 6-in. layer of fine material consisting of sand with a clay binder was placed on the liner. Placement was done by a crane with a concrete placing bucket. This arrangement made it possible to reduce the drop of the material to about one foot. Final spreading of the fine material was done by men with shovels and rakes. A 6-in. layer of cobbles, ¾ in. to 3 in., was spread on the side slopes in the same manner. The coarse aggregate prevents removal of the cover material from the slope by erosion.

The result is a very neat appearing reservoir, completed in a minimum of time and at a relatively low cost. The cost of the liner in place was $0.475 per sq yd.

Expected life

Results of development work begun in 1954 by the Agricultural Research Service, cooperating with the Utah Agricultural Experiment Station, indicate that this liner should provide excellent seepage control. Although the first field installations were made a little less than six years ago, the excellent condition of these linings and the results of accelerated aging studies appear to justify the 25-year life assigned to them. Bulletin 391 of the Experiment Station, by C. W. Lauritzen, Frank W. Haws, and Allan S. Hymphreys, summarizes the results of these investigations.

The performance that can be expected from vinyl film linings was demonstrated during the construction and testing of the reservoirs. No losses above normal evaporation were noted. The material remained very flexible, even when the temperature dropped to freezing. The liner appeared to be very durable; there was very little damage during installation. The low cost of the material, along with the low cost and ease of installation, provided further evidence of its utility.

On slopes, coarse aggregate was placed over the fine material to prevent removal of the cover material by erosion.

World role of engineer hailed as St. Lawrence Project gets award

The potential ability of the engineer to bring about a better understanding among the nations of the world was heralded at Massena, N. Y., on May 19, as the St. Lawrence power and seaway project was presented the 1960 award for the Outstanding Civil Engineering Achievement of the Year, by ASCE. In making the award, Frank A. Marston, of Boston, President of the Society, called the St. Lawrence project "a rare demonstration of good will, in these troubled times, among the free nations of the world." He added that similar projects could be achieved throughout the world by engineers if they did not have the "hindrance of political influences."

More than 250 Americans and Canadians attended the ceremony, which was preceded by a tour of the vast development on both sides of the St. Lawrence River. At the ceremony, held in the administration building of the Moses Dam section of the international power plant, metal plaques citing the project as the outstanding civil engineering achievement were awarded each of the four entities involved—the seaway and power interests of both the United States and Canada.

Stating that much credit was due the management genius which went into the St. Lawrence project, Mr. Marston added it is true, also, that the feat was accomplished because engineers know how to work together, and in harmony. He referred to engineering as a language "common to all."

"It makes one speculate as to what might have taken place, in other parts of the world, if the engineers had their way in pursuing needed projects for the benefit of mankind, without the hindrance of political influences," Mr. Marston declared.

Receiving the plaques as representatives of the groups involved were: A. A. Kennedy, commissioner of the Hydro-Electric Power Commission of Ontario; A. G. Murphy, chief engineer of the St. Lawrence Seaway Authority; Robert Moses, chairman of the Power Authority of the State of New York; and Martin W. Oettershagen, deputy administrator of the Saint Lawrence Seaway Development Corporation. Representing the U.S. Army Corps of Engineers, which was the construction agency for the American seaway development, was Col. Loren W. Olmstead, F. ASCE, of Washington, who was the engineer in charge of the project.

Charles B. Molineaux, Vice President of ASCE for Zone I, presented the recipients to Mr. Marston. He credited the Canadians with the drive that got the seaway and power project going while the U. S. was lethargic. Mr. Molineaux pointed out that the job cost $1.1 billion, required 22,000 persons, develops 1,824,000 kw from 240,000 cfs of water—and it was built in five years instead of a planned seven years. He gave special credit to the engineers of the several authorities, the consultants, and the construction contractors in completing this great work on schedule.

Mr. Kennedy, in accepting the plaque for Ontario-Hydro, remarked: "ASCE

On the dais, left to right, are A. A. Kennedy, Ontario Hydro-electric Commission; Robert Moses, New York State Power Authority; ASCE President Frank Marston, who presented the awards; Vice President Charles Molineaux, who was master of ceremonies; A. G. Murphy, St. Lawrence Seaway Authority; M. W. Oettershagen, U. S. Seaway Development Corp.; and Col. L. W. Olmstead, U. S. Corps of Engineers.

AMERICAN SOCIETY OF CIVIL ENGINEERS
THE OUTSTANDING CIVIL ENGINEERING ACHIEVEMENT

is to be congratulated for having instituted an award for the Outstanding Civil Engineering Achievement of the year. Doubtless, it will encourage members of the profession to even greater efforts in the challenging years before us. I think it is particularly fitting that the initial award should be of an international nature and I feel sure that other joint Canadian-United States endeavors will be worthy of recognition in the future. The guiding hand behind our activities on the St. Lawrence was Dr. Otto Holden, chief engineer. He is a former Director of your Society, and his record of achievement in the field of hydraulic engineering has brought distinction to himself and to the organization which he has served for almost half a century . . . Completion of the St. Lawrence Power Project also marked the climax of a long and brilliant career in civil engineering for Gordon Mitchell, project director."

For the Canadian Seaway Authority, Chief Engineer Murphy commented on the high degree of cooperation: "During the recent years of planning, design and construction, the engineers of these four corporations have followed the splendid examples set by their respective governments, and by their senior officers, in working together in a most friendly and harmonious way to the realization of a common objective. To those who have actively participated, this has been a delightful and rewarding experience. . . . I wish to pay a particular tribute to Lawrence Burpee, Deputy Chief Engineer, who so ably and indefatigably carried the brunt of the load in guiding the planning, design, and construction of the Canadian portion of the Seaway.

In accepting the award for the U. S. Seaway Development Corporation, Mr. Oettershagen said the true recipients are legion. They include President Eisenhower, who insisted the legislation be approved, and Congress which passed the legislation that made possible the participation. He paid tribute to "personnel of the U. S. Army Corps of Engineers, who skillfully and painstakingly designed every detail . . . in the U. S. section of the seaway," with special mention for Col. Loren W. Olmstead, district engineer for the Buffalo District Office, who was largely responsible for the supervision of the entire work program required on the project.

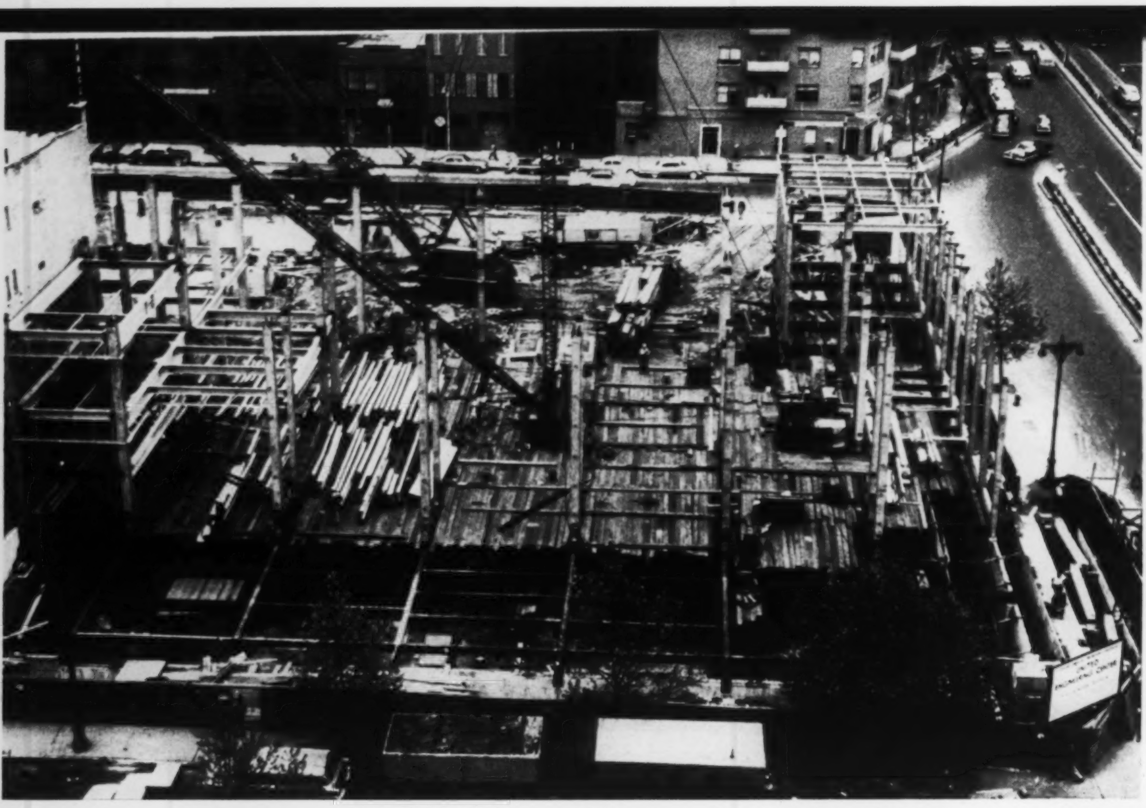
Receiving the plaque for the U. S. power plant, Mr. Moses said: "Speaking for the Power trustees and all those associated with our efforts, I offer our warm appreciation to Mr. Frank A. Marston and the American Society of Civil Engineers for this recognition. . . We deliberately avoided the time-consuming and costly attempt to build a staff of our own. Because of the archaic professional laws of New York State, which limit corporations practicing engineering, we were unable to retain the Charles T. Main Corp. Instead we hired the partnership of Uhl, Hall and Rich, professional engineers recognized in the State of New York, who are in fact the Charles T. Main Corp. . . ." Mr. Moses took the occasion to present to Uhl, Hall and Rich the National Safety Council Award of Honor for having 1,269,912 injury-free hours on the project.

"In my years of building this has been one of my most rewarding experiences" said Mr. Moses. "The Power Authority of New York and Ontario-Hydro jointly constructed the St. Lawrence Power project at a cost of $650,000,000 without ever having a signed contract or agreement between them! It should serve as an example to all the world that character, integrity, loyalty and mutual trust cross all borders, surmount all barriers, and foreshadow an era of international good will."

The Achievement Award is for the project and all who participated from early promotion through planning to completion of construction.

Special Plaque For Allegheny County Disposal System

Special Honorable Mention was given the Allegheny County Sewage Disposal System, the choice of District 6 for the Outstanding Achievement Award. This $100 million facility, completed in 1959, serves the City of Pittsburgh and 60 surrounding communities. Here Executive Secretary William H. Wisely is seen presenting the special plaque, on behalf of the Society, to John F. Laboon, executive director of the Allegheny County Sanitary Authority. From left to right are Merritt A. Neale, chairman of the Pittsburgh Section's Public Relations Committee; Mr. Wisely; Pittsburgh Section President Michael A. Gross; Robert C. Mathes, secretary-treasurer of Section; and Mr. Laboon.



Steel starts upward for the United Engineering Center. Bordered by First Avenue (far right) and 47th (lower center) and 48th Streets, the UEC site is the scene of considerable construction activity as the steel frame begins to take shape.

Have you done your share for the UEC?

Over at 47th Street and United Nations Plaza, there is organized bustle as contractors, subcontractors, and steel fabricators push ahead with steel erection for the new United Engineering Center. First steel was placed on April 29, and already (May 17) the steel skeleton for the two-story portion of the center rises impressively. Back in the old headquarters building, in the meantime, the participating societies are laying out their floor plans.

In the less dramatic but equally essential work of fund raising, there is progress, too, though not at the hoped-for rate that will assure success in closing the campaign in June. The ASCE campaign is now 94 percent completed, with $749,809 of the Society's quota of $800,000 collected or pledged. This handsome sum comes from only 13,790 members—less than one out of three of the Society's 45,000 members. Surely the many members who have not yet contributed will want to have at least a token share in the new center—symbol of the profession's claims to leadership and enhanced status.

How about your pledge?

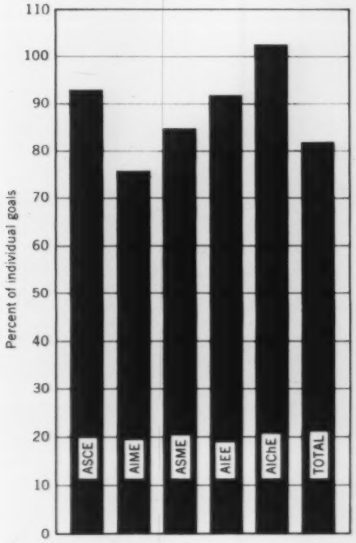
- Just make out a check to United Engineering Trustees and mail it to Society Headquarters.
- The staff will handle details—see that the pledge is properly credited to your Section.
- Formal acknowledgement will be made directly to you in the form of a receipt from U.E.T.
- The receipt can then be used to support your income tax deduction.

Let's finish the job—this month!

UEC HONOR ROLL

This month the Spokane Section takes its place on the Honor Roll as the 37th Section to achieve or pass its quota in the campaign for funds for the United Engineering Center. The 41 other Sections with varying amounts to raise are listed in another item. The distinguished 37 are listed here in the order of making their goals.

Kentucky (122)
Lehigh Valley (138)
Nashville (102)
Cincinnati (141)
Columbia (135)
Philadelphia (152)
Hawaii (128)
Rochester (123)
Ithaca (142)
Southern Idaho (200)
Indiana (138)
Delaware (109)
Kansas City (116)
Central Pennsylvania (109)
Arizona (110)
West Virginia (140)
Central Ohio (107)
Tri-City (116)
Puerto Rico (117)
Wisconsin (105)
Georgia (110)
Maryland (108)
Tennessee Valley (107)
Metropolitan (114)
Connecticut (107)
Maine (103)
Rhode Island (100)
Alaska (107)
Central Illinois (107)
Syracuse (107)
Illinois (103)
Nebraska (105)
Iowa (105)
Duluth (100)
Virginia (100)
San Francisco (101)
Spokane (101)



ASCE member giving for the United Engineering Center, as of May 13, is 94 percent completed

Total Amounts Necessary to Meet Local Section Quotas

Buffalo	$ 221	Dayton	$1,074	North Carolina	$1,869	Mid-South	$4,209
Panama	295	Oklahoma	1,076	Cleveland	1,900	Oregon	4,964
Tacoma	342	Akron	1,077	Miami	1,965	Louisiana	6,570
Mexico	675	Intermountain	1,108	Rep. Colombia	1,970	Florida	7,324
Montana	688	Seattle	1,346	Venezuelan	2,183	Colorado	8,292
New Hampshire	827	Texas	1,468	South Carolina	2,277	Michigan	9,440
Mid-Missouri	857	Mohawk-Hudson	1,587	Sacramento	2,573	Nat'l. Capital	11,331
South Dakota	874	Kansas	1,699	San Diego	2,742	Los Angeles	13,911
Massachusetts	951	St. Louis	1,763	Pittsburgh	3,163		
Wyoming	1,005	Brazil	1,795	Northwestern	4,039		
Toledo	1,072	New Mexico	$1,830	Alabama	4,041		

(More ASCE News on Page 74)

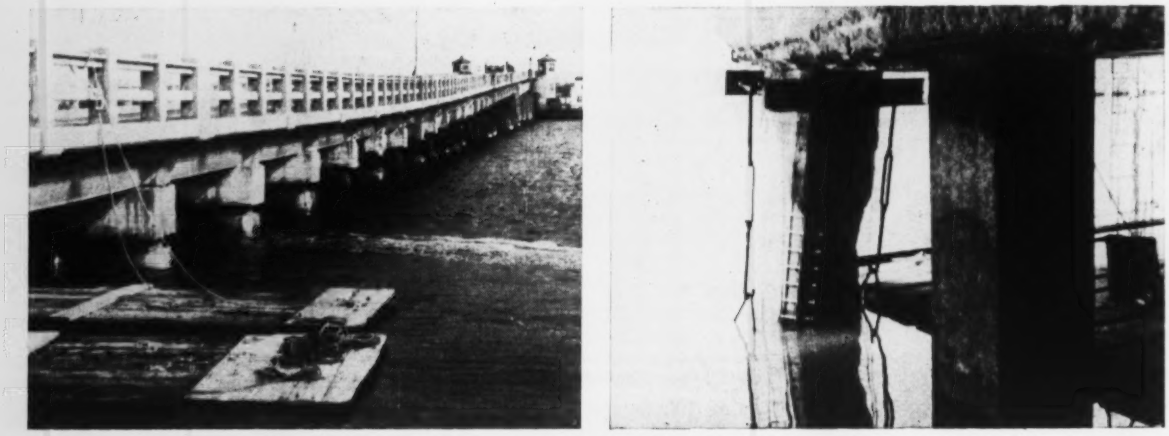
As a cogent *Engineering News-Record* editorial put it in the earlier days of the campaign, when the rate of contribution was less than one of four members, "For the usual type of fund-raising campaign, only 25 percent support may be acceptable, but it is shockingly low for a project involving such a high degree of professional responsibility and plain self-interest as this one. Not only is the UEC badly needed to replace the present inefficient and wornout headquarters of the nation's principal engineering societies, it will also—by its size, modernity, and prominent location—symbolize the engineer's important place in the world and suggest to all and sundry that the importance is deserved."

On the optimistic side, many of the Local Sections are putting new spirit into the drive to meet their quotas. Now there are 37 Sections on the UEC Honor Roll, with the Spokane Section the newcomer to the list since the May issue went to press. The Los Angeles Section is being commended for a new and clever idea—"guarantors," a picked group, pledged to collect $1,000 each from Section members—which is now paying off. In the far-flung Texas Section the campaign is more than 96 percent completed. In his May 16 letter to fund-raising personnel, Executive Secretary Wisely comments on significant gains made, since his last letter, in the Buffalo and Mohawk-Hudson Sections. He notes, too, that "Renewed, reorganized solicitation is underway in the Alabama, Intermountain, Seattle, Kansas, Cleveland, Mid-South, New Hampshire, Oregon, and Colorado Sections. Other Sections," he adds, "including most of those over their quotas, continue to plug along."

Says Mr. Wisely, in conclusion, "The United Engineering Center will be a permanent record and reminder of this campaign. Every member who contributes will always be glad that he did so. Every Local Section that meets its quota will bring lasting pride to its members and its officers.

"Where does your Section stand? It is *not* too late if you act now with confidence and determination."

Scene at UEC construction site on April 29 when the first steel column was placed. Executive Secretary Wisely shows his pleasure at progress of construction. United Nations Building looms in background.



Above, deteriorated concrete and foundations piles on a New Jersey highway bridge were repaired by pumping colloidal grout into steel jackets without dewatering. At right above, support material is in place for pile encasement.

Colloidal grout repairs concrete piles without dewatering

SAUL GRAND, President, S.T.G. Construction Company, Inc., New York, N. Y.

Precast concrete piles, driven in 1932 to support bridges along the New Jersey coast, had eroded as much as 10 in. when they were recently repaired by pumped colloidal grout without dewatering. Four precast concrete pile trestles between Ocean City and Somers Point are in this project of the New Jersey Highway Department. The piles are 1 ft 10 in. square with chamfered corners. Tide, weather, and ice abrasion had reduced the section to one foot in severe cases. All the deterioration was in a 5- to 8-ft length in the area of tide fluctuation. Since the main reinforcement had lost less than 20 percent of its original section, replacement was not required.

Specifications for reconditioning the 750 defective piles required the placing of jackets around them and the use of either preplaced coarse aggregate concrete or of plain grout pumped around the piles. The pumped grout had to have a cement-sand ratio of 1 part portland cement to 2 parts sand. A cylinder strength of 3,000 psi after 28 days was required; grout additives, if any were used, had to be approved.

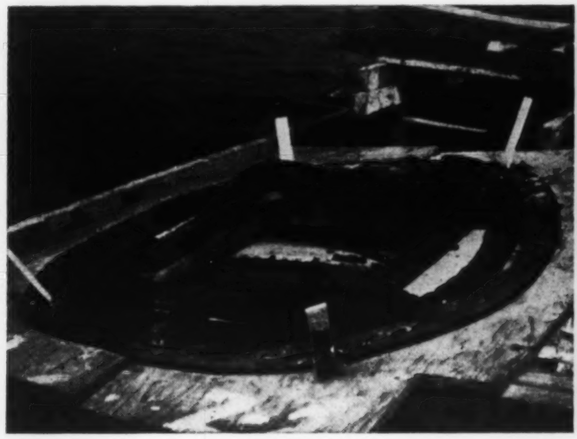
The bid of the S.T.G. Construction Company, which was low and on which the contract was awarded, was based on the pumped-grout alternate. S.T.G. had had experience with pumped colloidal grout on repairs to granite-faced piers supporting sections of the Franklin D. Roosevelt Drive along the East River in New York. That work was done in the dry inside cofferdams. A 56 M Colcrete colloidal grout mixer was used with a Colmono Pump No. 4 to apply grout under a pressure of up to 125 psi.

The colloidal grout produced by this roller-type mixer was of such stability and so well suspended that it withstood the action of water, tide and current without washout or dilution when tested outside the cofferdam area. The results achieved were excellent and superior to those with grouts produced by conventional mixers. Therefore the grout alternate, using this method, was bid by S.T.G.

The batch used on the New Jersey bridges consisted of 12½ gal of water to 2 bags of cement and 4 cu ft of sharp, well graded concrete sand. The New Jersey Highway Department tested about 100 samples, using various additives to establish control for setting time, fluidity, plasticity, strength and air entrainment. However, the best results were obtained using no additives other than an air-entrainment admixture. A cylinder strength of more than 5,000 psi at 28 days was consistently obtained.

In the field, the first operation was to clean the existing piles. This was done with pneumatic tools and sand-blasting. A diver did underwater cleaning where necessary. When the piles were cleaned, wire mesh was fastened around them. This 4-in.-square mesh, of No. 8 wire both ways, weighed 44 lb per 100 sq ft.

To hold the grout encasement around the pile a steel jacket was required,



Rubber stripping on separable plywood base makes the bottom closure.

Deteriorated pile bent and beams for superstructure are ready for repair.

Two-drum Colcrete DD8 colloidal grout mixer stands on deck of a bridge under repair. Colloidal grout with 5-in. slump was pumped as much as 75 ft by the mixer alone, without the use of a separate pump and compressor, to complete several bents from one setup.

leaving an annular space of 3-in. minimum width. A 6-in. ship channel was held to each side of the pile immediately under the cap by bolts tightly drawn up. An additonal bolt, a few inches from the pile, with a pipe sleeve slipped over it, was used to support a bottom closure form that carried the jacket. The bottom was built in halves, arranged to be put together under water.

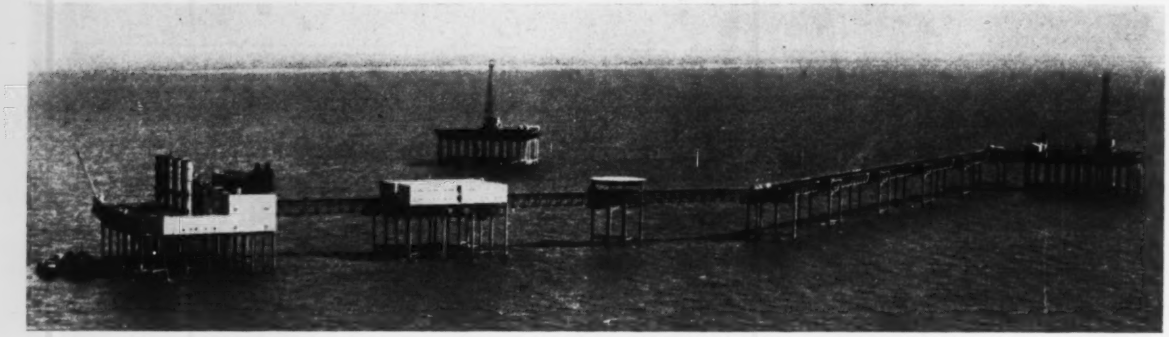
As the form always was placed below deteriorated or spalled areas, rubber stripping was used around it so that it would fit tightly against the sides of the pile to provide a closure against grout loss. The base and seal were installed by divers and held vertically by means of turnbuckles to the channel support above. Height of encasement required varied from 6 to 8 ft. The jacket, fabricated in two pieces from galvanized steel, was attached with bolts around the pile and was left in place for semipermanent protection of the concrete.

A Colcrete colloidal two-drum grout mixer of type DD 8 (8 cu ft per batch) was set on the bridge deck. The cement slurry is produced in the first drum and the sand is added in the second drum to produce a stable and pumpable colloidal type of sanded grout. A high shear is created in the pump housing; the narrow gap arranged for the flow of the grout, combined with a shaft speed of 2,000 rpm, produces grout in perfect suspension and completely stable. A 2¼-in. hose was used to pump the colloidal grout into the pile encasement over a radius of 75 ft. Colloidal grout with a slump of 5 in. was pumped at a delivery pressure of about 30 psi directly into the form. The Colcrete DD 8 colloidal grout mixer mixed and pumped the grout, and a considerable saving was obtained by eliminating a separate grout pump and a compressor.

Because of its nature, the colloidal grout displaced the water in the form without bleeding or washout of cement, leaving a dense, impervious grout jacket that gave the required surface strength and protection. The top of the grout jacket was beveled so that water would drain off, away from the concrete. A most important part of this operation is the fact that the colloidal grout can be placed without dewatering the form. This greatly simplifies the preparation of the form as all possible water leakage must be prevented.

Deteriorated concrete in the caps and beams above the piles was cut away to good material. Then wire mesh was attached and mortar applied by pneumatic means to build the section back to its original dimensions. By these simple means the project was completed several months ahead of schedule.

G. Weissblum was superintendent for the S.T.G. Construction Company, Inc. For the New Jersey State Highway Department, Carl Weller was District Engineer, Paul Geisler was Area Engineer, and C. L. Petersen, Director and Chief Bridge Engineer.



Power plant at sea is supported 54 ft above water 45 ft deep by 42 steel-pipe piles 30 in. in diameter and nearly 300 ft long. The power plant can be seen at far left. Next comes living quarters, then heliport and, at far right, production platform. At platform in background, waste water is withdrawn from sulphur dome daily.

A power plant 7 miles at sea, built just above wave height and strong enough to resist hurricane winds of 120 mph, is a major structure in the Freeport Sulphur Company's project to open a new source of this important chemical. The unusual plant supplies power and 5 million gallons per day of hot water at 325 deg F for mining sulphur below the ocean floor. Power from the plant is used to push the sulphur ashore through the 7-mile underwater hot pipeline described by E. J. McNamara, M. ASCE, in the April issue of CIVIL ENGINEERING. The power plant is supported 54 ft above the water (here 45 ft deep) by 42 steel-pipe piles 30 in. in diameter and nearly 300 ft long.

POWER PLANT AT SEA

Part 1. Plant and equipment layout

H. R. DAVIES, Jr., Director, Bedell & Nelson Engineers, Inc., New Orleans, La.

Located in the Gulf of Mexico 7 miles from the Louisiana shore, a unique power plant provides hot water for mining sulphur and power to pump it ashore. Because of its unusual location, this plant presented many problems to its builders.

1. Primarily, the supporting structure had to be designed to withstand the most severe forces produced by hurricane winds and waves.

2. The design had to provide for as much fabrication on shore as possible, keeping the prefabricated parts within the limits required by available erection facilities.

3. The size of the plant had to be kept to a minimum. A good example of space at a premium is the use of two spiral staircases of the lighthouse variety employed here as a last resort.

4. It was necessary for the equipment to be arranged so that the weight center of gravity would be very close to the dimensional center of the platform.

5. Since the only available source of water is the sea, the corrosive effects of handling sea water had to be reckoned with. This was done by using a variety of metal alloys, plastics and coatings.

To some, the words "power plant" as applied to such a facility in the sulphur industry might be misleading. Although 5,300 kw of electric power can be produced by this plant, the actual power produced requires only a small percentage of the boiler capacity, which is primarily needed to heat 5 million gal per day of sea water to a temperature of 325 deg F.

Briefly, the system works as follows. Sea water is lifted by vertical pumps up to the plant pump deck at an elevation 54 ft above the water level. Incidentally this elevation was selected after very careful study of hurricane waves; the pump deck is just out of reach of the crest of the highest wave anticipated. The water is then preheated with boiler stack gases after which it is sent at high pressure through heat exchangers where it attains a temperature of 325 deg F. From here it is piped to the production area and later into the wells.

With an accurate flow sheet and a fairly accurate estimate of equipment weights from previous plants (at the outset very little major equipment had been purchased) the task of determining the relative location of each piece of equipment was undertaken. Since it was desirable to locate the weight center close to the dimensional center, it was necessary to move around such items as 700 tons of boilers, 200 tons of heat exchangers and 600 tons of preheaters in much the same way as living-room furniture might be rearranged.

After it was concluded that the center of gravity was as close as practicable to the desired location and the equipment was basically in line with the direction of product flow, deck elevations were determined.

Between the pump deck and the operating deck 22 major systems of piping had to be routed. Most of this piping had to run around or at least completely across the plant. Some of this space had to be occupied by instrument trays, cable trays, conduits and innumerable miscellaneous small piping systems as well as catwalks, elevated tanks, hanger rods, and exhaust duckwork systems. The designers settled on a height of 21 ft between decks, but within this height 4 ft at the top was taken up by the structural members and, at the bottom, 9 ft was kept clear for personnel.

The structure was broken down into five bays of 34 ft each in the north-south direction and six bays of 27 ft each in the east-west direction. The main girders are 30-in. and 36-in. wide-flange beams with stringers of 12-in. and 8-in. beams spaced 3 ft on centers. Each piece of equipment has additional steel under it for support as well as to minimize vibration.

The Power Plant Building which houses the turbo generators and air compressors also supports the heat exchangers. It was almost completely field erected and consists of 36-in. wide-flange rigid frames spanning 54 ft and spaced 34 ft on centers. The heat exchangers were purposely located high because of the head required by the pumps that take suction from them. This double decking also helps to keep the overall dimensions to a minimum.

Also to be found on the platform is an elevator serving the three main deck levels and a ramp on the north and west sides to accommodate fork-lift trucks. Since most major equipment items and supplies are brought out by boat, three dolphins are provided on the west side to secure vessels while the crane unloads their cargoes.

Part 2. Design of supporting platform

T. H. ZUMWALT, *Senior Civil Engineer, Freeport Sulphur Company, New Orleans, La.*

In anticipation of possible opportunities for the mining of sulphur in the Gulf of Mexico, research had been begun 10 to 12 years before the final design of this structure was prepared. This research included visits to offshore oil drilling platforms and the assembly of pile driving records, boring data, load tests, and wind and wave data. Construction equipment was checked periodically, and operating experience was recorded. Further research included attendance at many technical meetings and panel discussions where offshore problems were considered. Hypothetical locations were selected and costs of structures, equipment, and operation were estimated to determine the feasibility of mining sulphur in the Gulf of Mexico. Estimates completed as early as 1948 were continuously revised to reflect new design methods, improved construction equipment, and cost trends.

Final design data assembled

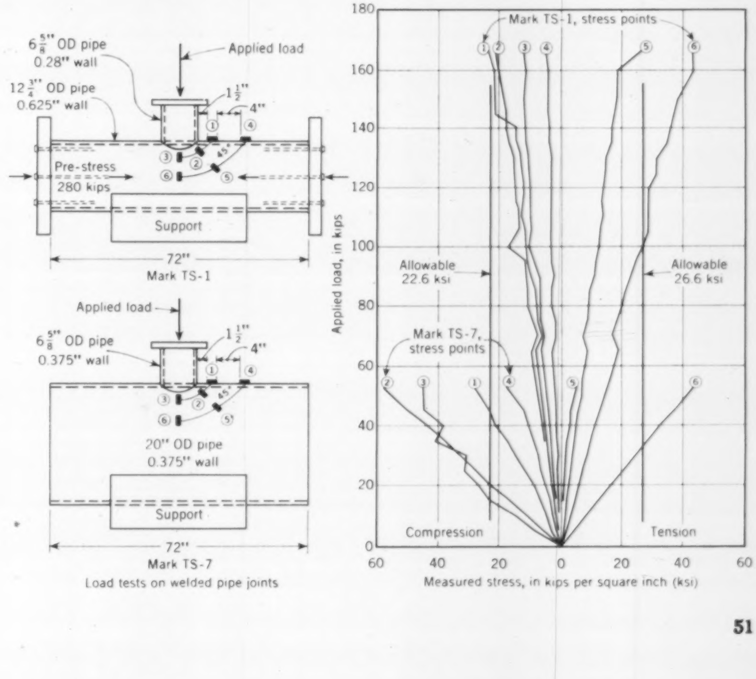
To augment the data previously assembled, meteorological and oceanographic consultants were retained to investigate the site and predict maximum wind and wave conditions. Soils consultants were retained to make borings, conduct laboratory analyses, and prepare evaluation reports. Daily wind and wave observations made near the site from 1948 to date were plotted and analyzed. Available records of hurricanes near the site were assembled and studied. Ground-line subsidence due to mining operations was calculated to determine its effect on the structure. Records of experience with corrosion were assembled and analyzed.

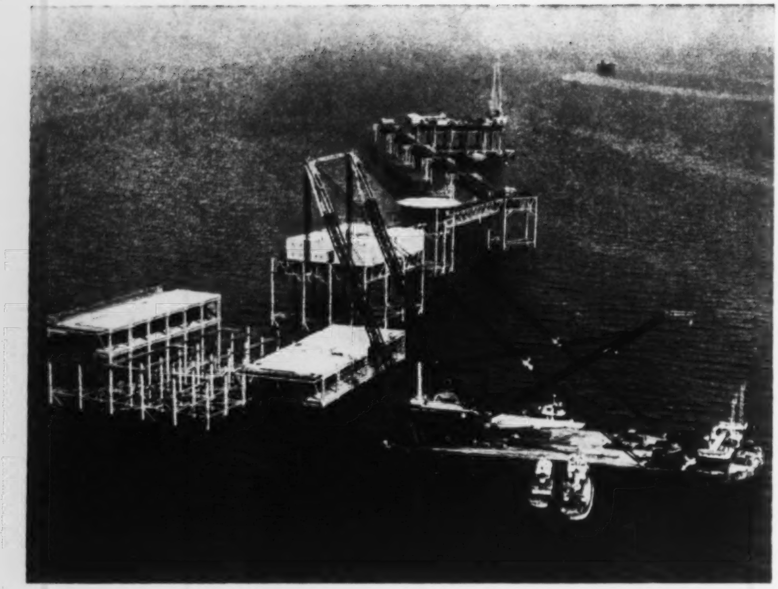
Typical welded-pipe framed joints were prefabricated and subjected to full load tests to determine allowable loads for various ratios of pipe diameter and wall thickness. The results of these unique tests were interesting; Fig. 1 gives a typical comparison. Load test Mark TS-1 shows that the ratios of diameter and wall thickness are adequate to the extent that measured stresses remain within allowable limits up to an applied load of 100 kips; failure occurred at a load of 213.5 kips. In test Mark TS-7, compression stresses at Points 2 and 3 exceeded the allowable at applied loads of only 15 to 20 kips; failure for this test occurred at a load of 60 kips.

Design conditions selected

Three hurricanes with winds above 100 mph have passed directly over the site since 1893. Since 1916 eight addi-

FIG. 1. Six SR-4 strain gages were placed at numbered locations for testing of typical framed joints in welded pipe. The results indicated allowable loads for various ratios of pipe diameter and wall thickness.





Floating equipment sets a 650-ton prefabricated section of the power-plant deck. This is believed by job forces to be the largest lift in construction history.

tional hurricanes with winds of 100 to 128 mph have passed within 30 to 160 miles of it. A reliable anemometer at Burrwood, La., 30 miles distant, measured sustained winds of 124 mph and gusts of 140 mph on September 29, 1915. Meteorologists predict that winds of 120 mph will occur at an average frequency of once every 100 years, and winds of 100 mph once every 10 years. A design wind force of 50 psf was selected, based on a sustained velocity of about 112 mph.

At this platform the water depth is 45 ft, and the 50-ft depth contour is a short distance to the southeast. A vertical ground-line subsidence of 5 ft at the platform is anticipated and greater amounts to the east, which will shift the 50-ft contour to the vicinity of the platform. The estimated maximum wave that can exist in the 50-ft depth will have its crest at El. 45, Mean Gulf Level. This wave can be generated by winds of 105 to 110 mph, a condition that is expected to occur once every 20 to 30 years, and which was selected as the design condition.

The calculated maximum horizontal wave force on round piling at the crest of the wave was 1,376 psf. To illustrate total horizontal forces on a line of circular piling at right angles to the crest, a cross section of the wave form is provided by the tabulation in Fig. 2, which was plotted to scale and moved across the piling until the maximum total lateral force was determined.

Three borings made adjacent to the power plant showed 6 to 10 ft of extremely soft clay followed by 7 to 9 ft of very soft clay, 40 to 70 ft of soft clay, and 90 to 130 ft of medium stiff to stiff clay. The borings extended 250 ft below Mean Gulf Level, and penetrated 22 to 28 ft into a stratum of very dense sand. It was indicated that the upper 25 ft of soil would be disturbed by lateral bending to the extent that skin friction support would be destroyed. The necessity of determining the point of fixity and plane of contraflexure below mud line was also emphasized. The top 50 ft of clays was sampled continuously and all necessary laboratory tests were performed to provide information for making such calculations.

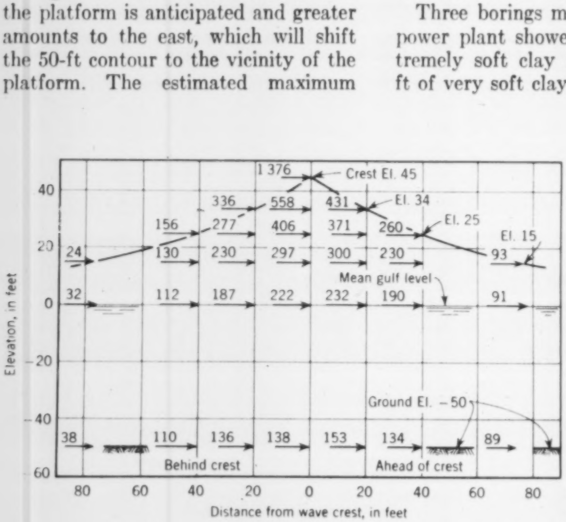


FIG. 2. The calculated maximum horizontal wave force on round piling at the crest of a wave was 1,376 psf. Tabulation, at top, shows horizontal forces on the round piling in pounds per square foot.

The ultimate vertical supporting capacity of steel-pipe piles of 30-in. diameter was found to be 335 to 425 tons per pile in the clay and 750 to 870 tons if imbedded in the sand. The total required length of piles was found to be 280 to 300 ft. The selected design basis for vertical support incorporated a factor of safety of 2 for dead load only, and 1½ for combined loads. Indications that subsidence would cause horizontal movement of the structure were investigated thoroughly to determine possible adverse effects on skin friction support. Observation of existing structures under similar conditions, the extremely slow rate of lateral movement, and the observed rapidity with which piling "set up" in clay, all precluded this possibility.

Corrosion experience at existing offshore structures, and materials and methods used to combat corrosion were carefully analyzed. A method of protection was developed for each of three corrosion environments. In the totally submerged zone, below El. − 2.0, cathodic protection was selected. Elsewhere the sacrificial metal method was adopted. In the splash zone, from El. − 2.0 to El. + 15.0, ⅜ in. of additional metal above the design requirement was added to template legs, and concrete grout was placed between the template legs and the piles. All template bracing members above El. − 2.0 include ⅜ in. of additional wall thickness. In the zone of salt air above El. + 15.0, piles, portal trusses, and bracing were chosen to give ⅛ in. of additional thickness. Corrosion resistant paints and coatings were also provided in this area.

Design calculations

A firm of consulting engineers was retained to collaborate in the selection of design bases, and to prepare necessary design calculations, construction drawings, and details. The typical framework employed is shown in a transverse section in Fig. 3. The structure is shown in the subsided condition with respect to Mean Gulf Level. All elevations are 5 ft below the con-

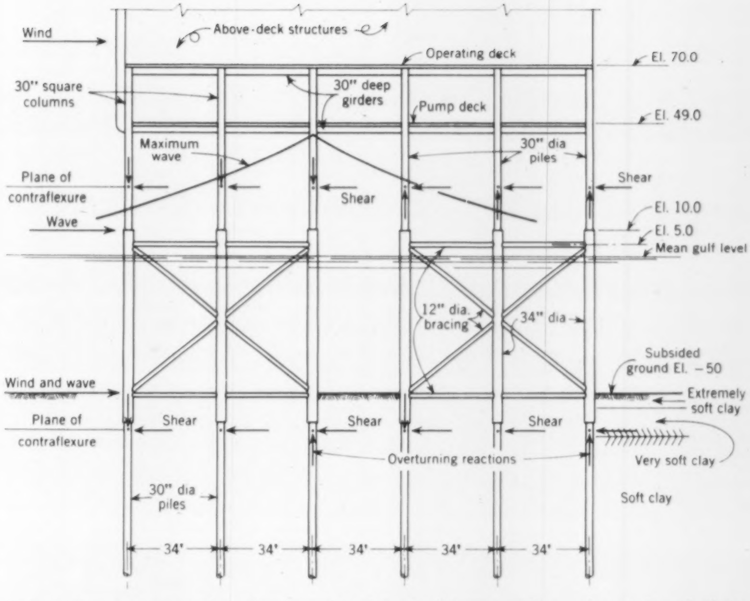


FIG. 3. Transverse section shows general typical framework employed for platform to support power plant.

struction elevation, the condition on which design calculations were based. A total of 42 steel pipe piles of 30-in. diameter were employed, six in the transverse direction here shown, and seven in the longitudinal direction.

Outstanding design considerations

A horizontal wind force of 50 psf was applied to all structures and framing above the pump deck. The total resultant wind force was applied about 80 ft above Mean Gulf Level, and distributed equally to six piles in shear. Additional forces caused by a part of the wave crest above the plane of contraflexure were also distributed equally to all piles in shear, and considered locally at each pile in the calculation of bending stresses.

Operating-deck and pump-deck girders were chosen to support the vertical deck loads with additional strength to resist flexual stresses caused by horizontal forces, thereby providing fixity at the upper ends of the pile columns. Braced piling templates provided fixity at the lower ends, which completed the basis for locating the upper plane of contraflexure. Shears, bending moments, and overturning reactions for girders and columns above this plane were computed in the usual manner.

Indicated excessive horizontal wave forces dictated the locations of deck framing and equipment above the maximum anticipated wave crest. Supporting pile columns throughout the area of maximum wave force were spaced as widely as possible, and held to the minimum diameters required to resist shear, bending, and deflection. Location of the lower pump-deck framing was such that it will be about 6 in. above the maximum wave crest in the subsided condition, which will occur near the end of the mining operations. The resulting unsupported length of pile columns above the braced template is about 40 ft. Considering the 30-in. pile diameter and fixity at both ends, this length is not excessive.

Construction equipment

Available construction equipment determined the size and design of the pile templates, and consequently the stress calculations for the entire structure. A completely braced 42-pile template would have weighed about 800 tons, and its pickup points would have been beyond the lateral range of existing cranes. Therefore two 21-pile sections were designed, with three piles in one direction and seven in the other, as shown in Fig. 3. Each section weighed about 350 tons. The verticals, of 34-in. diameter, were framed with horizontal and diagonal braces of 12-in. diameter. Bracing members were held to a minimum in number and diameter, yet made large enough to resist lateral and axial forces, and to provide for corrosion losses.

The approximate position of the total resultant wave force is shown a few feet above Mean Gulf Level. Actually forces were applied to each pile, strut, and brace, overturning moments determined in each case, and the moments combined as necessary to investigate various conditions. Generally, the total horizontal wind and wave forces were distributed equally to six piles in shear below the template, and overturning reactions were calculated separately for each of the two template sections. The resultant effect on stresses in framing members above the templates was also considered.

Perhaps the most unusual and important consideration of all was the location of a point of fixity and a corresponding plane of contraflexure for piling in the soft clay below the templates. This determination also affected stress calculations for the entire structure. The most recent available data concerning this problem were secured and consulting assistance was retained. The problem consists, generally, of accumulating the lateral resisting strength of the soil, downward from the surface, versus the applied shear force, and plotting the resultant deflection and moment diagrams.

It is evident that results can vary widely depending on the magnitude of the shear force, the diameter and bending strength of the pile, and the strength of the soil into which the pile is driven. For this structure, the plane of contraflexure was estimated to be about 12.5 ft below the ground line, although bending stresses in piles were carefully investigated to a depth of 90 ft. All overturning moments and reactions were calculated from this plane, and the stresses throughout the structure were adjusted accordingly.

Except for unique conditions not covered by existing building codes, some of which have been discussed, the whole layout, the application of loads, and the design calculations were made in strict accordance with the recommendations of the American Institute of Steel Construction and the American Welding Society.

It is concluded that the offshore data and experience assembled before the final design was prepared were adequate, that the meteorological, oceanographic, soils, and structural consultants retained were among the best available, that the design calculations and details were prepared in accordance with good construction practice, and that the structure will provide safe support for the power plant under the most severe physical conditions that can be anticipated at this time.

(These articles are based on the papers presented by Messrs. Davies and Zumwalt at the ASCE New Orleans Convention, before the Power Division session presided over by Marcel P. Aillery, chairman of the Division's Executive Committee.)

Fire damage to concrete repaired by a new technique

At quitting time a few months ago the South Bronx Marine Transfer Terminal—a project of New York City's Department of Public Works on Hunts Point, midway between the Triborough and Whitestone Bridges—was 97 percent complete. It was almost ready for use by the Department of Sanitation as a transfer point for refuse to be moved out to sea for disposal.

At 8 a.m. the next morning the building was charred and gutted, the result of an overnight fire that had fed on timber in the building's bumper and slip system.

At first glance the building appeared to be a complete loss. A detailed survey, however, indicated that, although substantial damage had been done to the concrete members, walls, dumping-room floor and roof, as well as to the bumper and slip system, structurally the building remained sound. Engineering consultants for the insurance agent therefore recommended remedial measures, the most interesting of which was the refacing of the concrete members at the slip elevation, including pile caps, tie beams and columns up several feet from the splash area.

Here, of course, New York's Commissioner of Public Works, F. H. Zurmuhlen, F. ASCE, demanded that the repaired concrete mass be sound and watertight and dimensionally similar to that described in the original design so that the members would again have adequate fire and frost protection. To do this conventionally would require complete removal of all concrete and the placing of entirely new concrete members since even gunite over old concrete leaves a joint penetrable by water and subject to deterioration.

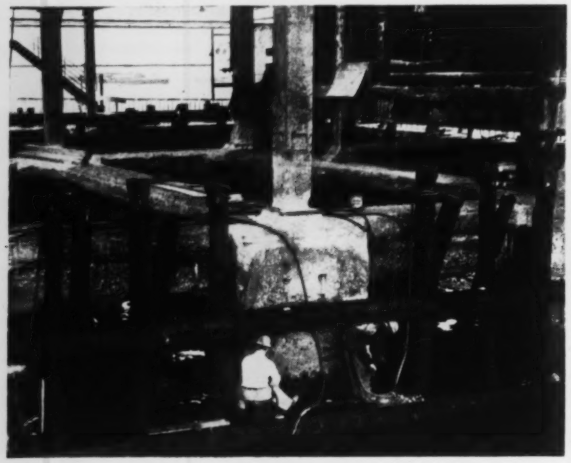
Complete removal of the concrete was definitely undesirable. The reinforced concrete pile caps serve as structural supports to carry the load of the shed-type building. Removal of these caps would require the dismantling of the entire structure and rebuilding after the new pile caps had been installed—a job that might well take four years of additional construction time.

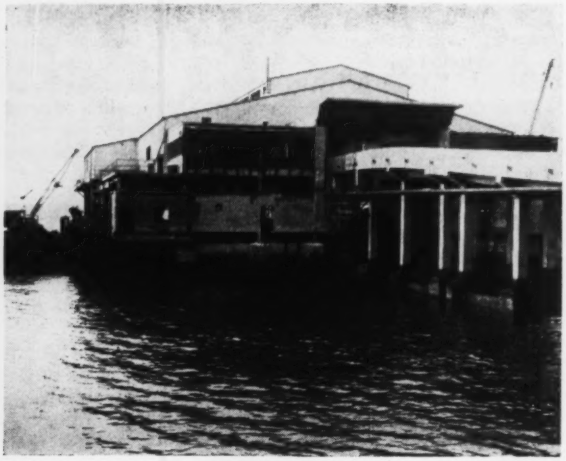
Repair time cut to one year

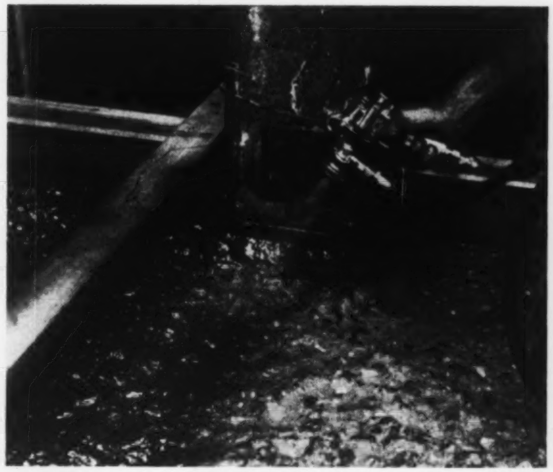
To cut this repair time to one year and provide three years of operating time for the Department of Sanitation, the engineering consultants recommended the use of polysulfide containing epoxy adhesive in a technique that would restore adequate soundness to the concrete pile caps, tie beams and columns and make it necessary to remove only the concrete that had been damaged.

The consultants pointed out that polysulfide containing epoxy compounds had proved effective in the repair of concrete highways. Properties of the compound had made possible the application of thin concrete overlays to concrete and asphalt bases and had prevented the usual penetration of water and moisture and subsequent cracking during freeze-thaw cycles. See

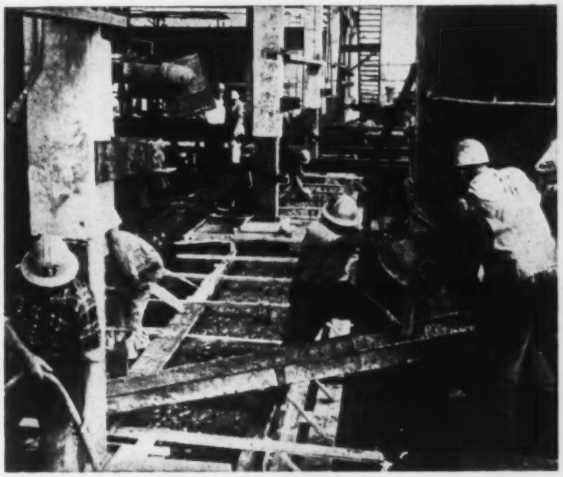
Extent of fire damage to New York Sanitation Department's South Bronx Marine Transfer Terminal. Workmen are chipping damaged concrete from pile caps with air hammers. Removal pattern was such as to leave square edges with adequate seats to facilitate proper pouring and provide good support for new concrete. Below, the terminal is seen from shore after repair work had begun. Trucks will enter the building by the ramp to dump refuse into barges. Building stands on piles.







Adhesive is sprayed over old concrete at the rate of a gallon per 120 sq ft. By providing a strong bond between old and new concrete, the adhesive assures the same watertightness in the repaired members as in the original undamaged ones.



Adhesive being applied in background was allowed to become tacky, but not dry, before concrete was placed. The repaired members, which now have passed through one winter of freeze-thaw cycles, appear completely sound and watertight.

"Epoxy Adhesives in Concrete Construction," by R. W. Gaul and A. J. Apton (Civil Engineering for November 1959, p. 50). That these adhesives are practical and durable had been demonstrated in reports of the California Division of Highways and of the Corps of Engineers in Cincinnati.

These reports indicated that not only does the adhesive make a watertight joint between new and old concrete, but it provides a bond that is stronger than the parent concrete. Thus it was established before the remedial work on the Bronx Terminal was begun that once sound concrete was bared, the new concrete layers could be bonded effectively to it. No new reinforcing would be required nor would the concrete have to be handled in any special way.

Instead of removing all the concrete from the pile caps, tie beams and columns, essentially only the damaged sections were chipped away with jackhammers. Concrete was not always removed down to the reinforcing steel but it was always removed to fairly uniform depths. Square edges and complete seats were left on the columns and pile caps to facilitate pouring of new concrete, to eliminate the need for feather edging and to provide adequate support for the new facing.

New forms were built around each member since all the new concrete in this area was to be poured rather than sprayed. As soon as forms had been completed in an area, part of the working crew applied compressed air to blow off dust and concrete fragments.

Immediately after cleaning, a two-man crew sprayed on a polysulfide-epoxy adhesive produced by Protex-A-Cote, Inc. Because spraying of the compound was a fairly rapid operation, the same two-man team was able to mix the two-part adhesive as well as apply it. The ingredients were mixed in a conventional pressure paint pot, about five minutes being required to achieve adequate dispersion. A regular paint-spray hose and nozzle were used. To these was attached a compressor supplying a pressure of about 40 lb.

The adhesive was allowed an open film time of two hours, after which the placing of concrete began. Because each operation could be handled by fairly small crews and the time lag between each operation was short, the entire refinishing procedure in this area moved rapidly and without too much additional supervision.

Temperature disregarded

Repair of concrete at the slip elevation was done during the fall on both warm and cold days. The temperature did not go below freezing but no special consideration was given to temperature during the application of the adhesive.

After a winter of many freeze-thaw cycles, the concrete resurfacing has not shown any signs of failure. An intensive examination of the pile caps, tie beams and columns, has failed to reveal even hairline cracks. Thus the remedial work in this area of the project has been deemed successful.

The polysulfide epoxy adhesive used, like similar formulations now covered by a purchase description written by the Corps of Engineers, is a two-package product requiring the combination of equal parts of both ingredients. Since it consists of 100 percent solids and is a low-viscosity fluid, for this use 15 percent of toluene solvent was added to provide better handling characteristics. The formulation provided a pot life of three hours. Nozzles had to be cleaned out with toluene after each batch in the pressure pot had been exhausted, but the hose was cleaned only at the end of the work day.

The adhesive was applied at the rate of one gallon to every 110 to 120 sq ft. Water, of course, was no hazard to proper curing of the adhesive as might be expected from its ability to bond to new concrete. Only standing bodies of water had to be removed from such areas to make sure that the adhesive was laid on the concrete properly.

Above the splash area concrete fireproofing throughout the building was chipped down below the reinforcing bars and gunite applied to build up the concrete to the desired depths. In these areas watertightness was not essential.

The South Bronx Marine Terminal is expected to be ready for operation by the Department of Sanitation in the early summer of 1960. Design and construction of the building were supervised by the Department of Public Works of the City of New York.

Material for this article was obtained through the cooperation of Eugene R. Rau, Vice President of J. Rich Steers, Inc., New York, N. Y., contractors for the original project and for the repair work.

Concrete arch roof of Machine Hall for T-2 project is shown completed. Excavation is still in progress to establish floor level of turbines and generators, which is 75 ft below the established level of the assembly-bay floor in background.

Australian power project

CLARENCE L. GRANGER, Senior Engineer, Kaiser Engineers, Oakland, Calif.

Holing through of a three-mile headrace tunnel three months ahead of schedule marked another milestone in the construction of Australia's Snowy Mountains Scheme. Hard-rock miners of the Kaiser-Perini-Morrison-Raymond Joint Venture completed this phase of the construction of the T-2 powerhouse project on March 10, 1960.

This underground powerhouse is being constructed on the Tumut River in New South Wales, for the Snowy Mountains Hydroelectric Authority. Besides the powerhouse and the headrace tunnel, the principal features of the project are the diversion dam, two pressure shafts, and the tailrace tunnel. The contract for this $45,000,000 project was let in June of 1958 with a completion date of September 1963.

Scheme includes 15 power stations

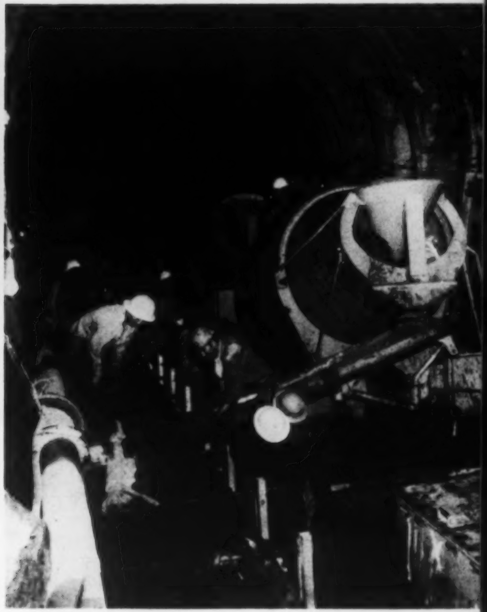
The T-2 power station is the third of fifteen that will be incorporated in Australia's vast Snowy Mountains development, which is aimed at obtaining the most economic use of the sparse water supply of this dry continent. Australia's average annual rainfall is 16½ in., about half that of California, and its total runoff is about equal to that of the Columbia River, whereas its total area is about the same as that of the United States. Furthermore, much of the precipitation is restricted to the eastern slopes of the Great Australian Dividing Range, whence it flows back to the sea and is of little benefit.

The Snowy Mountains Scheme is designed to gather and store these waters during the spring runoff and divert them westward under the Dividing Range through more than 80 miles of tunnels to the Tumut and Murray rivers. These two rivers will bring the water to the dry plains to the west where it is so badly needed for irrigation. The Authority estimates that an additional 2,000,000 acre-ft of water will be available annually for irrigation when the Snowy Mountains Scheme is completed. The entire cost of the scheme will be repaid from income received from the sale of power generated by the 15 power stations. The additional water made available for irrigation will be furnished at no cost to the users.

World's record for tunneling

Before starting the T-2 project, a Kaiser-Walsh-Perini-Raymond joint venture completed three earlier contracts for work on other parts of the scheme. First to be completed was the Eucumbene Dam (formerly known as Adaminaby Dam), an earth and rockfill structure a half mile thick at the base and 381 ft high—the second highest of its type in the world. Next to be completed was the Tumut Pond Dam, a concrete-arch structure 670 ft long at its crest, and the T-1 pressure tunnel. Most recently completed was the concrete lined Eucumbene-Tumut Tunnel, which is 21 ft in diameter and 14 miles long. Both the Eucumbene Dam and the Eucumbene-Tumut Tunnel were completed two years ahead of schedule. A world's record for tunneling in hardrock was set during one six-

Skip-mounted section of steel penstock lining 24 ft long is lowered into place. Pressure shaft in which the men stand is at end of 3-mile-long T-2 headrace tunnel of 21-ft diameter. Pressure shafts slope at 54 deg; they are 935 ft long and 11 ft 6 in. in diameter.



While excavation in headrace tunnel is in progress ahead, curbs are being placed. Note arch-form anchor bolts.

ahead of schedule

day week when the Eucumbene-Tumut Tunnel was driven 484 lin ft from one heading.

On the T-2 project, the gravity-type diversion dam now under construction across the Tumut River will be 145 ft high and 370 ft long. It will contain 66,000 cu yd of concrete and will divert water into a headrace pressure tunnel, concrete lined for its full length, with a circular cross section 21 ft in diameter.

The headrace intake structure includes a trashrack and a fixed wheel gate 17 ft × 21 ft to allow the tunnel to be dewatered for inspection and maintenance. A concrete-lined headrace surge chamber 28 ft in diameter and 250 ft high is provided at the downstream end of the headrace tunnel in order to relieve the system of pressure surges when the turbine valves are being closed. Two inclined steel-lined pressure shafts (Fig. 1), each 11 ft 6 in. in diameter and 935 ft long and sloping at 54 deg, carry the water from the headrace tunnel to the four

An 8-cu yd rock storage car enters T-2 pressure shaft to deliver aggregate for Prepakt operation. Shaft is on 54-deg slope.

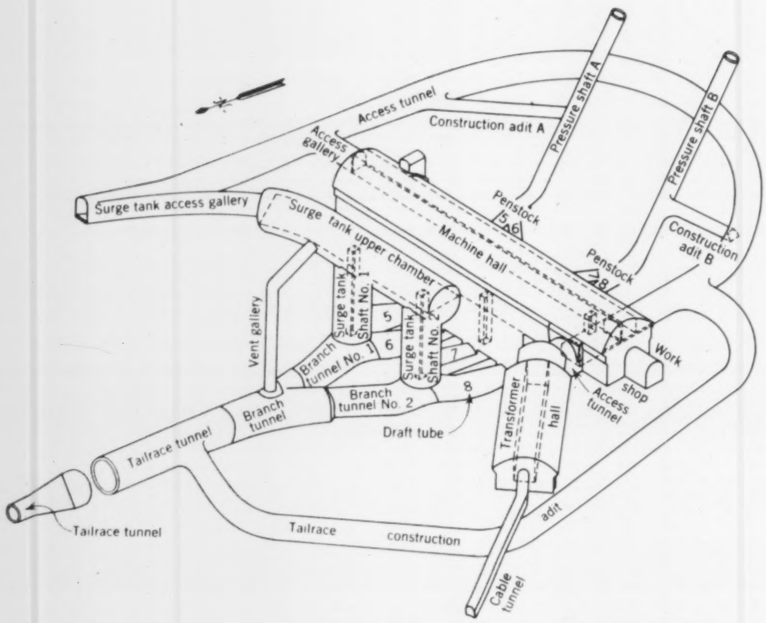


FIG. 1. Schematic diagram shows T-2 power station and shafts 800 ft below the surface. The Machine Hall is 350 ft long, 50 ft wide and 100 ft high. The Transformer Hall is 175 ft long and 47 ft in height and width.

penstocks leading to the turbines in the powerhouse machine bay.

Except for the first 300 ft of the headrace intake portal, all excavation for the three-mile headrace tunnel has been done from one heading begun at the downstream end. It was reached through a construction adit 300 ft long. Entrance to the power station during and after construction is through an access tunnel of 3,600-ft length. This horseshoe-shaped access tunnel, 16 ft high and 18 ft wide, has a maximum grade of 12 percent.

Powerhouse excavation

The access tunnel was first driven into the powerhouse and a construction adit was then continued from the access tunnel around the powerhouse and into the tailrace tunnel. Two additional construction adits were also driven from the access tunnel into the two pressure shafts. These adits made it possible to carry on the powerhouse excavation simultaneously from several locations, and to excavate the pressure shafts by rising rather than sinking.

The underground powerhouse is located in the heart of a mountain 800 ft below grade at an elevation of 1600 ft. Four 70,000-kw generators, each driven by a 96,000-hp turbine, will supply a total of 280,000 kw of power. Power from the transformer hall will be brought to the switchyard at the surface through an inclined cable tunnel 9 ft 6 in. square, 500 ft long and sloping at 34 deg.

Excavation of the powerhouse is rapidly nearing completion. Placing concrete on the roof and walls is under way. The two pressure shafts have been excavated and steel liners are now being concreted into place using the prepack method. The tailrace tunnel is 60 percent excavated and will be holed through by November 1960. Placing of concrete curbs in the headrace tunnel has been following closely behind the excavation, and placement of arch concrete was started in April 1960. All construction required to make water available to the turbines is scheduled to be completed by November of 1961. The Authority will place the first two generating units in operation early in 1962 and the remaining two in the latter part of the same year.

After passing through the turbines, the water discharges through four draft tubes into two branch tunnels which in turn merge into the four-mile tailrace tunnel. The first 1,000 ft of this tunnel is 30 ft in diameter and the remainder 21 ft. The tunnel, which has a circular cross section, will be fully lined. Since the tailrace portal will be flooded during normal operation, a tailrace surge chamber has been provided at the junction of the draft tubes and the branch tunnels, to relieve surges in the discharge part of the system.

Excavation for the four-mile tailrace tunnel has been carried out from one heading, started at the outlet portal, with the exception of 1,000 lin ft with a cross section 30 ft in diameter done from the powerhouse end.

A cofferdam 1,200 ft long has been constructed to prevent flooding of the tunnel through the tailrace portal during construction. As an extra safety measure, a watertight emergency steel bulkhead door has been installed at the outlet. Emergency exit from the tunnel through this bulkhead is through the 36-in. vent pipe.

Living accommodations

Before work on this project could be carried out, it was necessary to perform a considerable amount of related construction. Living accommodations had to be built for the 1,650 workers required. Four camps, a trailer park and "Sue City," a town of a hundred homes, were constructed. In addition to the basic living requirements of quarters, mess facilities and utilities, it was necessary to provide stores, recreation centers, schools, churches, hospitals and fire stations. More than eleven miles of access roads, including several bridges, had to be built.

An aggregate plant was built to process the rock excavated from the headrace tunnel and powerhouse to provide the 350,000 tons of coarse aggregate required. A sand deposit was opened up and a process plant built. Concrete batching and mixing plants were erected at three locations, and construction shops and buildings at five construction sites.

Two diversions under way

Two other major construction projects in the Snowy Mountains Scheme are at present under way—the Tooma-Tumut diversion and the Murrumbidgee-Eucumbene diversion. The Tooma-Tumut diversion will deliver water from Tooma River to the Tumut Pond Reservoir through a 9-mile tunnel being constructed by Thiess Bros. Pty Limited, an Australian firm. The Murrumbidgee-Eucumbene diversion will carry water from the Tantangara Reservoir on the Murrumbidgee River to Eucumbene Lake through a 10½-mile tunnel being constructed by Utah Australia Ltd.

Partners in the Kaiser-Perini-Morrison-Raymond Joint Venture are the Henry J. Kaiser Company; Perini Corporation; Morrison-Knudsen of Australia, Ltd.; R.C.P. Construction Company, Ltd.; and Bates and Rogers Construction Corporation. The Resident Manager for the joint venture is M. L. Fulton.

Sir William Hudson is the Commissioner for the Snowy Mountains Hydroelectric Authority and K. E. Andrews is the Engineer in Charge, Major Contracts.

Surveying instruments in mils

JOHN J. DURKIN, Chief

Applications Engineering Section

Surveying and Geodesy Branch

Topographic Engineering Department

U.S. Army Engineer Research and

Development Laboratories, Fort Belvoir, Va.

Now, almost 18 years after Philip Kissam, F. ASCE, first advocated a transit graduated in mils, his dream has come true. Modified versions of two popular Wild theodolites, reading in mils, have been developed by the U.S. Army Engineer Research and Development Laboratories, at Fort Belvoir, Va., with the cooperation of Wild-Heerbrugg Instruments, Inc., Port Washington, N. Y.

In Civil Engineering for September 1942, Professor Kissam, of Princeton University's Civil Engineering Department, made a strong case for graduating theodolites in mils.

In defining the mil he said, "One quadrant contains 1,600 mils, a circle 6,400. Fractional mils are always expressed in decimals. One mil subtends approximately a yard at 1,000 yd, so that the sine or tangent of 1 mil is about 0.001."

He proposed two types of verniers for engineers' transits, one reading to a tenth of a mil (about 20 seconds) for the larger transits, and the other reading to a half of a mil (about 100 sec) for the small, lightweight instruments.

He summarized the advantages as follows:

"1. Angles are expressed with fewer symbols. . . .

"2. Angles can be added or subtracted more easily.

"3. There is less chance of misreading angles in mils.

"4. Interpolation in any table is easy and no interpolation would be necessary in a five-place table for the usual transit accuracy.

"5. Quick approximate angular computation is simple when small angles are used: 1 mil = 1/1,000 radian to an accuracy of better than 1 part in 500."

The two Wild theodolites that have now been graduated in mils are the T-2 Model 56 and the T-16. In the T-2 Model 56, the horizontal and vertical circles are graduated to 2 mils, and each 10-mil graduation is numbered consecutively around the circles to indicate tens of mils. The micrometer is graduated to 0.002 mils with each 0.01-mil graduation numbered. Interpolation may be made to 0.001 mil. Thus Fig. 1 shows 319 tens of mils. After the graduations have been brought into coincidence, the units of mils are obtained by counting the number of graduations to the diametrically opposite division, 639. In this example there are 8. Tenths and hundredths of a mil are read from the figures on the micrometer drum and thousandths from the graduation markings, with interpolation from the half interval. Thus in this example:

319 tens of mils
8 units of mils
0.928 micrometer reading

3198.928 mils

In the T-16, the horizontal and vertical circles are graduated to 10 mils and each graduation is numbered to indicate tens of mils. Numbering is consecutive around the circles. Each circle has its own breakdown scale, graduated to 0.2 mil, with each mil numbered. Interpolation may be made to 0.1 mil. Thus, Fig. 2 shows for the horizontal circle, marked "Az,"

86 tens of mils
2.3 from breakdown scale

862.3 mils

and for the vertical circle, marked "V,"

623 tens of mils
8.7 from breakdown scale

6238.7 mils

These instruments will be issued to artillery units. The instruments will increase the speed and accuracy of artillery surveying by removing the need for working in two systems of angle measurement.

FIG. 1. Micrometer of Wild Theodolite T-2 Model 56, graduated in mils, is shown reading 3198.928 mils. See explanation in text.

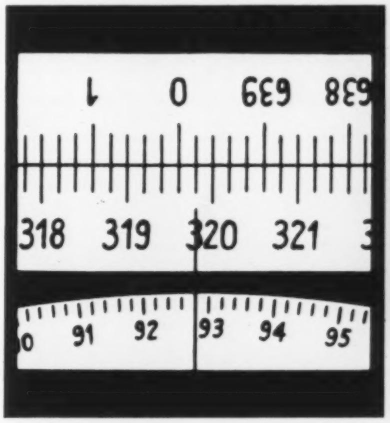
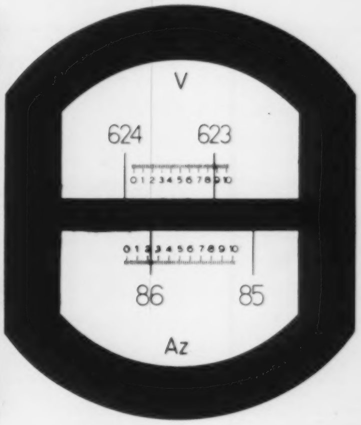


FIG. 2. Micrometer of Wild theodolite T-16, graduated in mils, is shown for a vertical reading of 6238.7 mils and a horizontal reading of 862.3 mils.



High-strength steels show economy for bridges

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In the design of heavy bridge structures the use of improved steels, with their attendant higher working stresses, has many applications which indicate increased efficiency and economy. For this reason more and more attention is being given at this time to the use of such steels as low alloy ASTM A242 and to the new quenched and tempered T-1 steel developed by the U.S. Steel Corporation.

With the increased use of welded steel fabrication in the past few years, the structural designer now has a much greater opportunity to make more efficient and economical applications of the available high-strength steels. It therefore appears that weldable high-strength steels are going to play an increasingly important role in the future design of heavy bridge structures.

The California Division of Highways has designed several structures involving the use of A242 and T-1 steels which have demonstrated increased efficiency and economy. These steels have excellent welding qualities and have higher working stresses than the customary structural grades ASTM A7 and A373 steels.

A review of the design of three of these structures with reference to the problems encountered, along with suggestions for possible improved efficiency in future work, is therefore of interest to the profession.

The Carquinez Bridge, completed in November 1958 across the Carquinez Strait, was the first major structure in the state to use these high-strength steels in large quantities. The Benicia-Martinez Bridge now under construction about six miles upstream from the Carquinez Bridge also makes use of large amounts of A242 and T-1 steels.

These two structures involve both heavy trusses and fairly long girder approach spans. The heavy truss spans were designed to use A7, A373, A242 and T-1 steels, while the approach girders were made of A242 steel.

A third and very interesting application of high-strength steels is in the design of three long girder spans across Whiskey Creek in Shasta County. Here T-1 steel has been found to have an economical and practical application in the make-up of the web and flanges for a bridge with continuous girder spans of 260 ft, 350 ft and 260 ft.

High-strength steels in trusses

In heavy truss construction full advantage can be taken of the higher-strength steels, since deflection and critical buckling criteria have only a slight influence on the design. As full efficiency can be obtained in their use, these improved steels can be relied upon to show considerable savings in the amount of steel along with a reduction in the cost of the structure. This saving in steel tonnage often reduces the dead weight sufficiently to effect still further savings by reduced loads on individual truss members, piers and foundations. Often another important advantage occurs when it is possible to reduce the depth of truss members by making a corresponding reduction in the secondary stresses.

The recently completed Carquinez Bridge is one of the first bridges in California on which ASTM A242 steel and the new T-1 steel were used extensively. (See Civil Engineering for January and February 1957, and *The Welding Journal* for April 1958.) This structure is a double cantilever type of truss with two main spans of 1,100 ft, two anchor arms of 500 ft, and a central tower span of 150 ft. Approach girder spans vary from 70 to 205 ft. The cantilever trusses are made up of three types of steel: (1) structural steel A7 and A373, (2) low-alloy steel A242, and (3) quenched and tempered steel T-1. The main girders of the approach spans were fabricated from A242 steel, and A7 and A373 were used in the bracing.

Quantities and bid prices for the main truss spans and the approach girder spans follow:

STEEL	TRUSSES		APPROACH GIRDERS	
	Bid price, ¢ per lb	Quantity, lb	Bid price, ¢ per lb	Quantity, lb
A7, A373	24.17	12,880,000	17.00	3,496,000
A242	27.52	10,740,000	18.00	7,000,000
T-1	34.76	5,820,000	....	.....

It was estimated that the use of the high-strength T-1 steel in members where it had an advantage over A242 steel saved 4,255,000 lb. Also the use of A242 instead of A7 or A373 yielded additional large savings in steel. The price differential between the types of steel was sufficiently favorable to result in very substantial savings in cost.

In this structure, completed nearly two years ago, the use of these high-strength steels has proved completely satisfactory from a design, fabrication and erection standpoint. In addition a considerable increase in efficiency and economy has been realized.

The Benicia-Martinez Bridge, shown

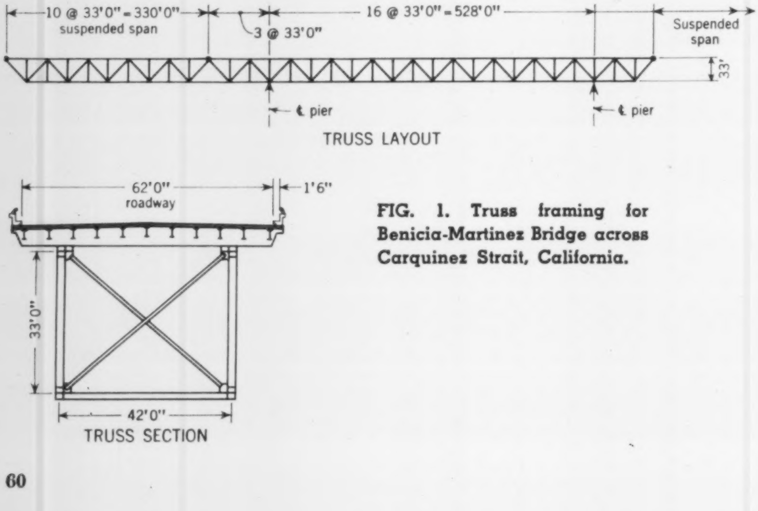


FIG. 1. Truss framing for Benicia-Martinez Bridge across Carquinez Strait, California.

in a retouched photograph, is now under construction across the Carquinez Strait. Like the Carquinez Bridge, it will include these same three types of steel and will be fabricated by welding.

The truss spans of the Benicia-Martinez Bridge are smaller than those of the Carquinez Bridge but are still reasonably heavy, having one span of 330 ft, two of 429 ft, and seven central spans of 528 ft. The truss framing is as shown in Fig. 1. The truss spans have been arranged for maximum duplication, requiring six simple spans at 330 ft and four continuous spans 528 ft between piers with 99-ft cantilever ends.

The types of steel used for the various members are shown in Fig. 2. Table I shows the allowable unit stresses for the three types of steel.

TABLE I. Allowable unit stresses, psi, for the three types of steel

Type of Steel	Yield Point	Tension	Compression
A7 & A373	32,000	18,000	$15{,}000 - 0.25\left(\frac{L}{r}\right)^2$
A242	50,000	27,000	$22{,}000 - 0.56\left(\frac{L}{r}\right)^2$
¾" and under A242	46,000	24,000	$20{,}000 - 0.46\left(\frac{L}{r}\right)^2$
¾" to 1½" A242	42,000	22,000	$18{,}000 - 0.39\left(\frac{L}{r}\right)^2$
1½" and over T-1, all thicknesses	90,000	45,000	$36{,}000 - 1.75\left(\frac{L}{r}\right)^2$

Choice of steel for each member was based on maintaining minimum plate thicknesses. That is, T-1 steel was used until minimum plate thickness requirements governed, then A242 steel was used. The same criteria governed the choice between A242 and A7. Unfortunately A242 steel loses efficiency in the thicker plates because of the reduction in allowable stress. Member make-up of a typical truss is shown in Fig. 3, which provides a comparison between the load capacities of A242 and T-1 steel.

Since all members were fabricated by welding, it was possible to provide a very economical means of compensating for the loss of net section in tension members at the joints. For instance, in tension members fabricated from T-1 steel, flange plates were increased in thickness at the joint for a distance one foot outside the gusset plate, where a butt weld was made to a flange plate of normal size. For tension members fabricated from A242 steel, the flange plates were kept the same thickness but changed to the higher strength T-1 steel by butt welding one foot out from the joint. Gusset plates varied in thickness and were of the highest type of steel for any member entering a particular joint.

Benicia-Martinez Bridge across Carquinez Strait in California, seen in retouched photograph, is now under construction. Seven center spans are 528 ft each.

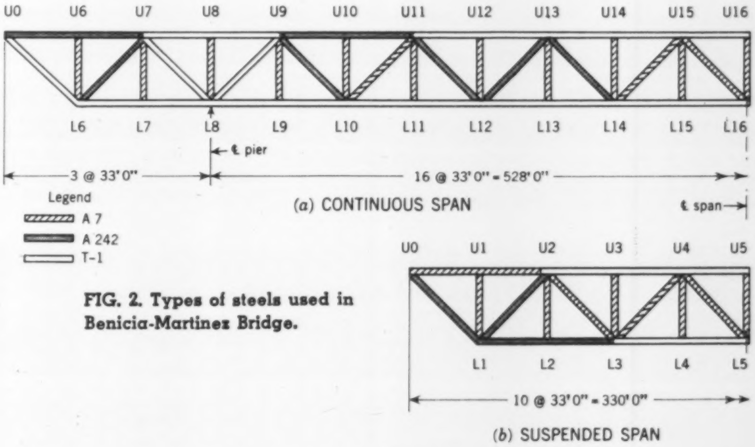
Quantities and bid prices for the Benicia-Martinez Bridge, as submitted by the contractor, Judson Pacific-Murphy Division of Yuba Consolidated Inc., were as follows:

Steel	Bid Price, ¢	Trusses, lb	Girders, lb
A7 & A373	18.57	11,618,000	402,000
A242	21.74	3,610,000	3,095,000
T-1	34.48	7,168,000	27,000

It is estimated that the 7,168,000 lb of T-1 steel in the trusses replaced 12,320,000 lb of A242 steel, indicating a saving of 5,152,000 lb of steel and a considerable saving in cost. The bid price per pound of steel does not have a differential as favorable to the high-strength T-1 steel as did prices for the Carquinez Bridge. This may be largely because the Benicia-Martinez structure included both truss and approach girder fabrication in one contract. This tended to lower the prices for the A7 and A242 steels.

Use of high-strength steels in girder design and construction does not have the big advantage in efficiency and economy that it has in heavy truss construction. This is due to the fact that limitations for deflection and for plate thicknesses have a much greater influence on the design of girders than on the design of heavy truss members. Nevertheless situations frequently arise where the bridge engineer must choose between using long shallow girder spans with high-strength steels or the more costly and less desirable through-truss type of structure.

This was the case in the design on the Whiskey Creek Bridge shown in Fig. 4. Here the use of T-1 steel made possible a practicable girder design and avoided the necessity of using a less economical and less desirable through-



(*a*) CONTINUOUS SPAN

(*b*) SUSPENDED SPAN

FIG. 2. Types of steels used in Benicia-Martinez Bridge.

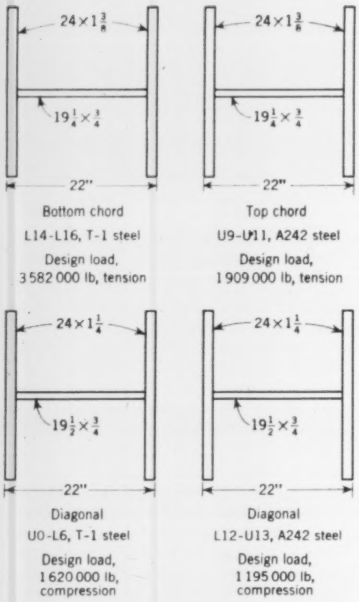


FIG. 3. Typical make-up of truss members for Benicia-Martinez Bridge.

truss type. The girders as finally designed were made up with some sections of the web and flanges of A373 steel, others of A242 steel, and the most heavily stressed flanges and webs of T-1 steel, as shown in Fig. 5 (*a*).

The girder section at the center of the suspended span, which is the area of the highest moment for the structure, is shown in Fig. 6 (*a*). If A242 steel had been used at this location, flange-plate requirements would have been 30 x 4½ in. with a unit stress of 22,000 psi. This thickness would be undesirable and impracticable, which demonstrates the advantage of T-1 steel for this design.

The AASHO specifications require that the deflection due to live load shall not exceed $L/800$ for the 350-ft span and not more than $L/300$ for the cantilever portion. This limited the live-load deflection for the 350-ft span to 5.25 in. and the 45-ft cantilever span to 1.8 in. To meet these restrictions it was necessary to reduce the fiber stress in the flange plates from 45,000 psi to 39,700 psi in the area of negative moment near the pier. Under these reduced stress conditions in the cantilever, the most severe live-load deflection for the 350-ft span was computed to be 4.00 in., which is well under the 5.25-in. maximum requirements. Although this deflection appears large, the deflection for one 20-ton truck followed by one 16-ton trailer is computed to be only 1.5 in., which is the most severe condition that would occur with any considerable frequency. From this it can be seen that the deflection limitations reduce the efficiency of high-strength steels when used in long-span highway girders. Unfortunately there appears to be no way of counteracting this loss in efficiency since the specification requirements for deflection are reasonable.

Minimum web-plate thicknesses with longitudinal stiffeners were determined by AASHO specifications according to the formulas $d/t \leq 270$ for A373 and $d/t \leq 220$ for A242 steel (where t=thickness of web plate, and d=unsupported depth). These proportions are based on critical buckling stress criteria for flat plates and are proportioned to prevent any local buckling of the web plate in the area of maximum stress. On this same basis, T-1 steel, which has a minimum yield strength of 90,000 psi, would be required to have a minimum web thickness of $d/t \leq 164$.

The thickness of web plates in heavy girder construction for highway bridges, where shears are usually relatively light, has a considerable effect on the efficiency of the design. For instance, in girder section Fig. 6 (*a*), the web contributes 47½ percent of the weight but only 22 percent of the moment capacity. This loss in efficiency is more pronounced for high-strength steels because of the criteria for buckling stress.

Fortunately plate-girder research now being conducted by the American Institute of Steel Construction at Lehigh University indicates that there may be a justification for revising the requirements for the minimum thickness of web plates in girders. If this should prove to be the case, the use of high-strength steels in plate-girder construction would show increased efficiency.

For instance, in a paper presented at the 1959 National Engineering Conference of the American Institute of Steel Construction, Konrad Basler and Prof. Bruno Thürlimann, M. ASCE, have this to say regarding the plate-girder research being conducted by the Institute: "A proper design and bracing of the compression flange is of greater importance to the strength of a girder subjected to bending than the proportioning of the web."

This research indicates that changing the web slenderness ratio from d/t=185 to d/t=388 did not affect the ultimate load capacity. On the other hand, maintaining identical webs but changing the proportions of the compression flanges indicated different ultimate load capacities.

From this they conclude that the buckling theory is not accurate for the carrying capacity of plate girders with thin webs. Hence, they say, specifications should not be based on this theory. It may be some time, however, before specifications are revised. In the meantime designers must make the most efficient use of high-strength steels in girder design under the present specifications. For instance, Figs. 5 and 6 show three possible sections that would satisfy moment and shear requirements for the girders at Whiskey Creek. The design actually used is shown in Figs. 5 (*a*) and 6 (*a*).

Since T-1 steel carries a rather large differential price over A242 steel, it would be more economical to make the part of the web that is least stressed from A242 steel. This would be eco-

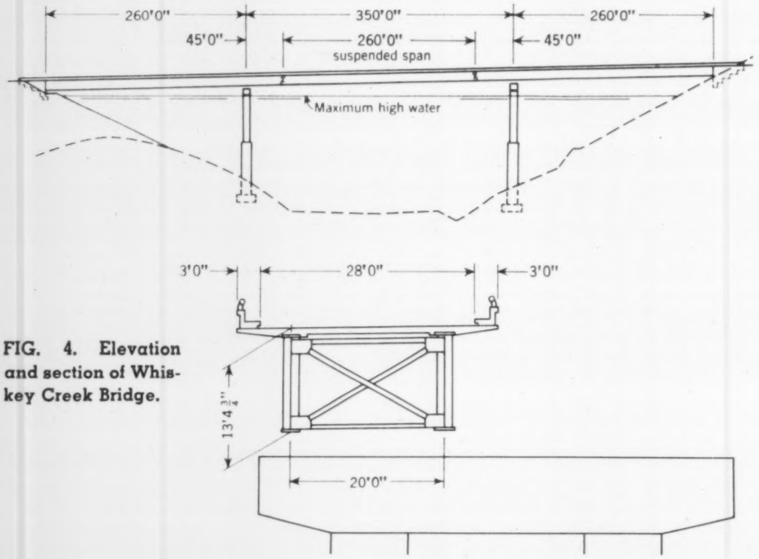


FIG. 4. Elevation and section of Whiskey Creek Bridge.

nomical only in cases where the price differential between the two steels was large enough to pay for the small amount of additional fabrication. The maximum plate size for T-1 steel is 132 in., which means that at least one longitudinal splice will be required in fabricating the 144-in. web plate. Changing the center portion of the plate to A242 steel would therefore require only one additional longitudinal splice. This procedure would reduce the amount of T-1 steel required for the two girders from 764,000 lb to 556,000 lb.

In some cases it might be advantageous to reduce further the amount of T-1 steel required by using a design similar to that in Fig. 5 (*c*) and Fig. 6 (*c*). In this design auxiliary flange plates have been added which would allow for a reduction in web-plate thickness from ¾ in. to ⅝ in. This would make a slight reduction in the total weight of the girder and reduce the amount of T-1 steel required for the design to 503,000 lb. This again would require more welding during fabrication and would be economical under certain price differentials.

On the Whiskey Creek Bridge, Gibbons and Reed Company was the successful bidder and the American Bridge Division of U.S. Steel was the fabricator and erector. Bid prices and quantities were as follows:

A373	400,000 lb @ 24 ¢ = $ 96,000
A242	475,000 lb @ 27 ¢ = $128,250
T-1	780,000 lb @ 36 ¢ = $280,000

From this discussion it can be seen that, in the design of highway bridge girders, there is some span length at which it becomes more economical to change to a higher grade of steel as the spans increase in length. The point at which it is desirable to make the change will depend on several factors such as the price differential, the span-to-depth ratio, the spacing of girders, and perhaps other factors peculiar to the particular job.

It is probably safe to say, however, that A242 steel will show economy over A7 and A373 steels whenever deflection or critical buckling requirements do not govern. For normal conditions it would appear that for spans well under 100 ft, A7 and A373 would be more economical, and for spans well over 100 ft, consideration should be given to both types of steel to determine which is the more economical.

T-1 steel should be considered in welded girder designs when the A242 flange plates become too thick to be practicable or too thick to maintain high allowable working stresses. T-1 steel should also be considered in long-span girders with deep web plates that would normally require, in any event, one longitudinal splice in the web make-up.

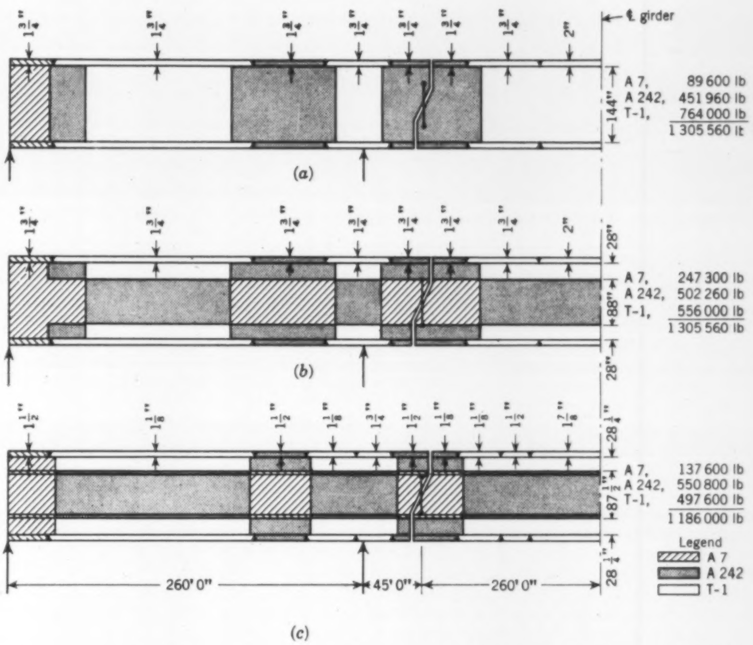


FIG. 5. Three types of steel were used in girders of Whiskey Creek Bridge as shown in (a). Two other possible arrangements, not used, are shown in (b) and (c).

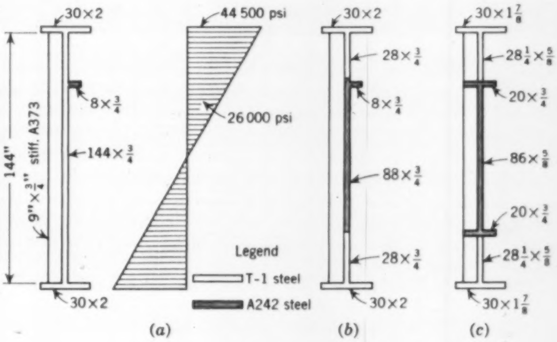
Conclusions

From the experience gained from these structures it can be concluded that:

1. High-strength steels are playing an increasingly important role in the design of heavy bridge structures.
2. Maximum efficiency and economy can be obtained in the use of high-strength steels in the design of heavy truss members.
3. The use of high-strength steels in girder design does not yield as high a degree of efficiency and economy as in trusses but in many cases these steels can be used to advantage with considerable efficiency and economy.
4. If future specifications for minimum thicknesses of web plates in girders are based on some criteria other than the critical buckling stress, then high-strength steels will yield even greater efficiency in long-span girder construction.

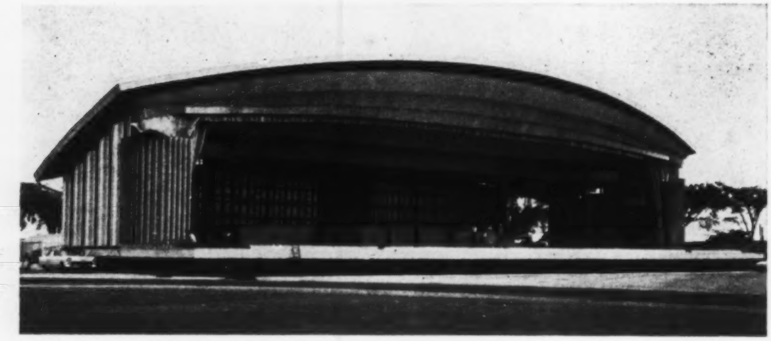
(This paper is to be presented by Messrs. Hollister and Sunbury at the ASCE Reno Convention, before the Structural Division session on Monday afternoon, June 20, 1960.)

FIG. 6. Girder section at center of suspended span, for Whiskey Creek Bridge, is given in (a). Two other possible sections, not used, are given in (b) and (c).



	(a)	(b)	(c)
Moment, ft-kips	41,450	41,450	41,450
Fiber stress, psi	44,500	44,500	45,300
T-1 steel, lb per ft	775.2	550.8	502.5
A242 steel, lb per ft	20.4	244.8	284.8

Finished stage, 160 ft wide by 80 ft deep, rides on ten smooth-track crawler units. Such an arrangement permits the use of the stage without destroying the turf and at the same time eliminates the necessity of constructing a temporary stage every year.



A MOBILE STAGE FOR CANADA'S

F. I. L. DYKE, A.D. Margison and Associates Limited

A 250-ton mobile stage mounted on ten motor-driven crawler units was the interesting solution found for an unusual problem that faced the Canadian National Exhibition Association (CNE).

As owner of a 20,000-seat grandstand overlooking a large field and cinder track, the Association had been contacted by the Toronto Argonaut Football Club, which wanted to use the field for professional football games. For this use the field would have to be kept in readiness for the football season. The conflicting use was in connection with the Annual Exhibition, which commences towards the end of August and runs for three weeks. It includes an afternoon and evening stage show that is put on daily in front of the grandstand. This show requires a stage approximately 160 ft wide by 80 ft deep, complete with scenery, lighting and a sound system. About two weeks are required to erect a temporary stage for three weeks of use, and one week to dismantle it. After this six-week period, the grass beneath the platform is completely destroyed.

Mr. W. M. Sills of the CNE conceived the idea of utilizing a mobile stage and called in a Toronto firm of engineers, A. D. Margison and Associates Limited, to report on the feasibility of such a scheme and eventually to design such a stage. It was decided that the stage should consist of a mobile platform with provisions for scenery, lighting and sound and that it should be possible to move the stage on and off the field without destroying the turf. Once the feasibility of such a stage was established, it was decided to add a roof over the rear three-quarters of the platform, with dimmer rooms, and sound and lighting control rooms in the wings.

The chief design problems centered around the trucks or roller units on which the stage was to move, the means of driving and controlling these units, and the rigid structural frame required to transmit the thrust from these units to the stage platform.

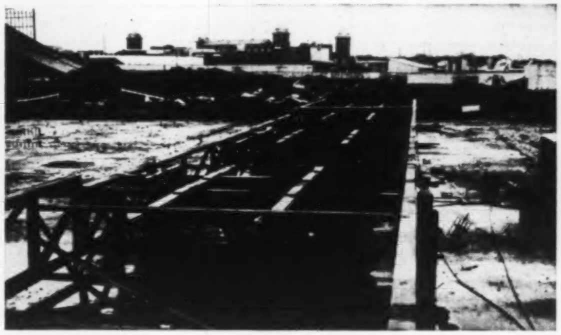
To permit the stage to move across the field without damage to the turf, it was found necessary to limit the load on all surfaces in contact with the grass to less than 10 psi. Steel rollers, pneumatic rubber rollers (roligons) and smooth-tread crawler tracks were all given consideration. The crawler tracks won out because they provide the maximum surface in contact with the ground with a minimum number of units.

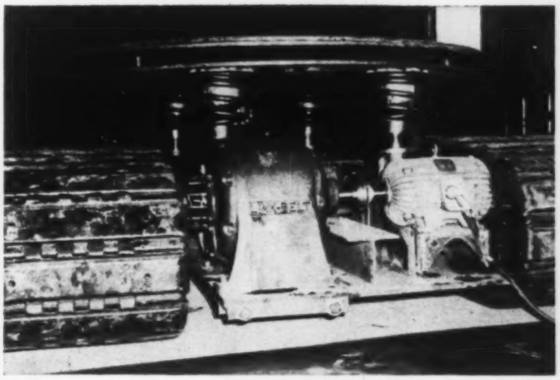
The stage was to be moved by electric power applied either through a winch and steel cables, or by electric motors mounted directly on the drive units. The motors could be powered by direct current from a gasoline-driven generator on the stage or by 550-volt a-c through a trailing cable. A suitable winch to move the stage would have to be quite large. Furthermore it would require a heavy foundation to anchor it against the pull, and the cable would have to be run through a block anchored on the opposite side of the field and returned to the winch via an underground conduit. The individually powered track units using alternating current were chosen since a trailing cable and a powered take-up reel could be provided quite economically. Direct-current motors with a gasoline-driven generator would have provided optimum starting torque and control but would have been more expensive than the method chosen.

The finished stage consists of a platform 160 ft wide by 80 ft deep at a height of 5 ft above the ground. This platform is made up of a box frame of structural steel which supports the 1-in. plywood decking and houses the ten smooth-track crawler units which move the stage. The rear 50 ft of the stage is covered with a roof to protect performers from the weather and to provide support for overhead lighting and the main curtain. In the wings, just behind the proscenium arch, are the sound-proofed dimmer rooms and above these the lighting control and sound control room. A lighting platform for large follow spotlights is also provided. Four steel catwalks concealed in the roof space provide mounting for and access to the overhead border lights and spots.

Each crawler unit consists of two smooth tracks with a platform mount-

A box frame of structural steel supports the 1-in. plywood decking for the 160-ft by 80-ft platform. Housed in the steel framework are the ten smooth-track crawler units that move the stage.





Crawler unit is seen with speed reducer, motor drive and main springs.

LARGEST ANNUAL EXHIBITION

Consulting Professional Engineers, Toronto, Canada

ed between them, supporting a speed reducer and an electric motor. The motors are all 10-hp high-starting-torque induction units. They are started simultaneously using one step of resistance starting, and are controlled from push-button stations located at each end of the stage platform.

The stage is provided with a complete lighting and dimmer system. Stage lights are fed through plugs located on the four catwalks behind the proscenium arch. Motor-operated disappearing footlights are installed across the front of the stage. Lights are controlled from a lighting control room.

Power for all stage lighting is supplied at 120/208 v through three 400-amp three-pole plugs which plug into receptacles located on the front face of the stage platform. The plugs are connected to underground power circuits in manholes with 50 ft of heavy-duty flexible cable.

Plugs and receptacles are provided for intercommunication telephone and sound circuits connected through the power manholes to the grandstand sound and intercommunication circuits. There is a sound-control room behind the proscenium arch from which all microphones and the sound system are monitored and controlled.

The CNE grandstand seats 20,000 and is 600 ft long. It is evident that a wide stage is required to serve an audience of this size. The proscenium opening is 130 ft wide by 28 ft high and the roof is formed from a segment of a sphere. The sides and front of the platform are sloped inwards at 45 deg so that the stage will appear to float across the field.

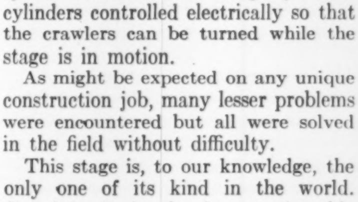
The traveling time required for the stage to move 400 ft from the storage pad to the position in front of the grandstand is five minutes, making its speed about 0.9 mph. Since the storage pad is located diagonally across the field from the grandstand, the crawlers must be set at an angle of 30 deg with the front edge of the stage, to permit diagonal movement without turning the platform.

Operating trials of the completed stage revealed that the individual crawler units did not all follow the same path going out and returning. It was found that the stage was tending to pull to the right both going out and returning to storage position. This produced the effect of turning the whole stage platform a few degrees so that the front edge ended up at an angle with the front of the grandstand. This angle increased every time the stage was moved. By trial it was determined that steering could be accomplished by actually turning the crawlers while in motion. The three front crawlers could steer the front end of the platform and the three rear crawlers could steer or control the movement of the rear of the platform, while all intermediate crawlers merely assumed a mean direction of travel. Subsequently a mechanical steering system was installed using hydraulic cylinders controlled electrically so that the crawlers can be turned while the stage is in motion.

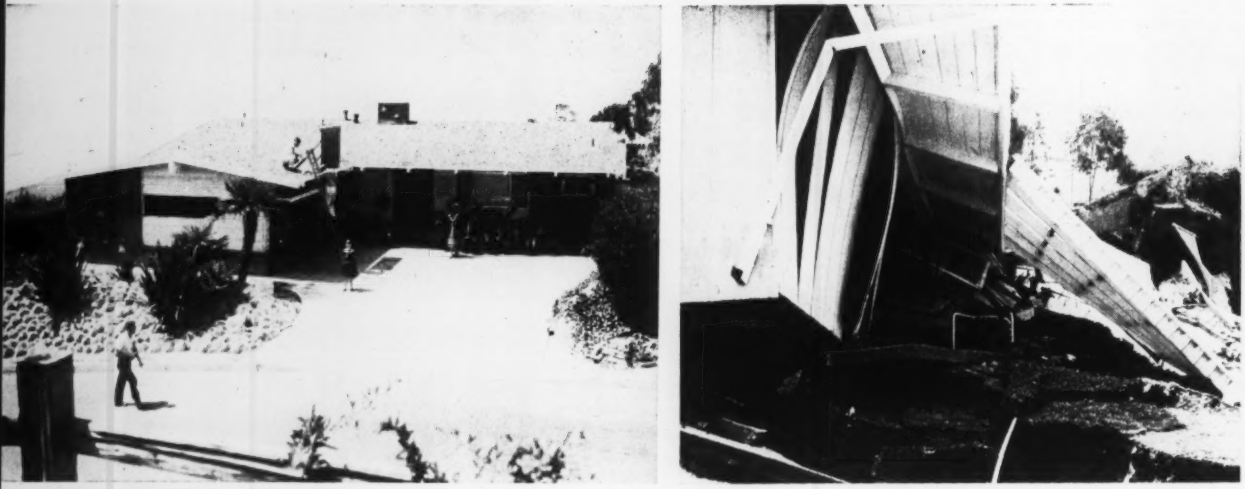
As might be expected on any unique construction job, many lesser problems were encountered but all were solved in the field without difficulty.

This stage is, to our knowledge, the only one of its kind in the world. Certainly it is the largest movable stage. Its weight is 250 tons with equipment and cast. It has attracted interest both as a stage and as a vehicle and has added extensively to the usefulness of the CNE Grandstand and field as well as doing away with the necessity of constructing temporary stage facilities each year.

FIG. 1. Ten electric motors mounted directly on the crawler units and powered by a trailing cable are used to move the stage from its storage position to a position in front of the grandstand.



HILLSIDE STABILITY—



A failure in a hillside environment was just beginning when photo above left was taken. Typical early signs of failure observed by home owners are jambing of doors and windows, cracked tilework, leaking shower pans, transverse cracks parallel to the crest of the slope in masonry structures, shattering of door and window glass, leaking water and sewer lines, rupture of lawn sprinkling systems and gas lines. At right the same structure is seen from the rear twelve hours later.

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What is the truth about causes and controls of landsliding and similar geological hazards?

Can sound and meaningful forecasts be made for the architect, the design engineer and the mortgage agency?

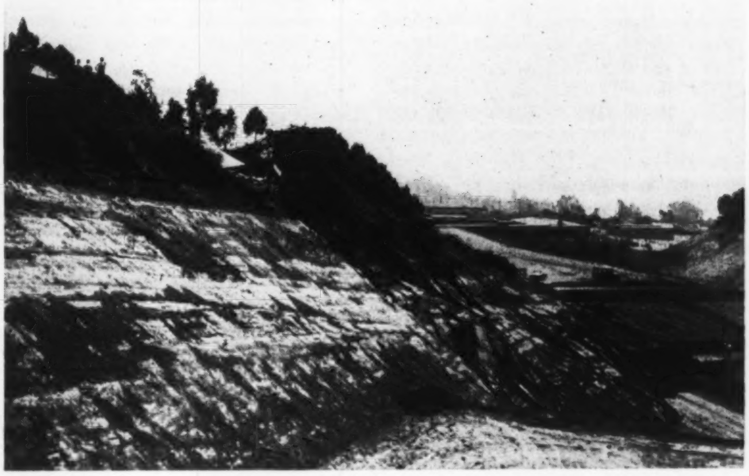
What economic rules should govern subdividing and construction in hillside environments?

Hillside and grading failures vitally affect reputations, assets, and liabilities of subdividers, lending institutions, insurance companies, contractors, architects and engineers. Millions of dollars in litigation grimly testify to the seriousness of the problems of landsliding and slope stability. The stake in invested capital and human safety, endangered frequently by the merest caprice of nature, is immense.

Experience has shown that the cost of cooperative presubdivision studies by top-flight engineering geologists and foundation engineers, in rocks that can be drilled with common rotary equipment, varies from about $25 to $200 per lot, depending on topography and rock types, accessibility, number of lots, and surveying control. Frequently overall costs can be reduced by mapping topography concurrently with geology, reserving more precise surveying for boundary and street layout. Unit costs increase as the size of the tract decreases; cost for a single residential lot may range from $200 to $1,000 if evaluated by specialists.

These are costs that few subdividers or contractors willingly assume if they can avoid it, yet protection of life and capital may be the dominant factors. No detailed fiscal analysis is needed, however, to show that the failure of a single developed building pad (and in some areas there have been dozens of failures in a single subdivi-

the modern approach



This is the slide that caused failure of the house shown at left. Although all code requirements had been complied with, both bedrock geology and foundation engineering had been inadequately evaluated. Bedrock failure brought result shown.

sion) may result in a loss of from $15,000 to more than $50,000, exclusive of personal effects, clean-up, legal fees, court costs and damage awards. In such circumstances, one can scarcely defend the thesis that, say $100 per lot for engineering and geological studies *before* the grading plan is prepared, is a burden on the subdivider. Many purchase agreements and a growing amount of financing require geological approval as part of the escrow. Then there is the concept of negligence, a legal point that has jolted many owners into an expensive awakening.

Few building codes offer appreciable protection against landslide and fill failure in areas such as those here discussed. A typical chain of events is given by Moore,[1] who states:

"In some areas a developer that places fill on property must file a statement with some state agency. The careful buyer, we'll say, investigates and learns this. The developer has put the fill in according to an engineer's plan, and it has been compacted to the 95 percent requirement of Federal Housing Administration standards. The purchase is made. The house slides off the hill. Everyone has met the requirements and therefore fulfilled his responsibility." To this might be added, "until the courts decide otherwise." There are many moot points in the legal aspects of landslides.[2]

In 1958, following disastrous but local landsliding in Southern California, the insurance companies elected to eliminate the nationwide landslide features in the popular "Home Owner Package" policies. Based on almost no study of the problem by experts in the field, this act not only deprived the carriers of millions of dollars in possible premiums, but also eliminated vital protection to policyholders in all hillside environments, hazardous or not.

In many coalescing urban areas in both the United States and Canada, the ready supply of level building sites, both industrial and residential, is being depleted with the result that construction is shifting to the hills, thereby frequently bringing man into direct collision with nature. In some cities millions of cubic yards of earth and rock are being moved each year to prepare sites, with more than 50 percent of all residential building permits being issued for construction in such environments.[3] As man takes more and more to what Jahns[4] has aptly named the "Heartbreak Hills," slope and earthwork failures increase. Unless financial institutions, control agencies and engineers face up to the hard facts of hillside development, the problem will worsen.

A recent survey of 724 members of the American Public Works Association, representing principal engineers and officials in 103 municipal, county, state and federal agencies, including the military, in the 12 Western States indicates an alarming lack of knowledge of causes, preventions and control of landslides, mud avalanches, soil creep, local runoff and ground-water pollution.

This survey connotes a prevalent tendency to oversimplify grading controls, presumably because of widespread ignorance of the factors causing landslides and like phenomena. Most frequent cure-alls are the approval of proposed grading plans by *any* registered civil engineer or approval by *any* professional engineer; compaction of soils and fills to arbitrary standards; grading to arbitrary slopes (most commonly to 1 on 1 or 1 on 1½); corrective planting (even though earth compacted to 90 or 95 percent will support no crop); construction of retaining walls; approval by a geologist; or approval by a "soils" engineer. Some regulations merely require fill compaction sufficient to "resist erosion." Of course one or more of the above measures may be required in a given case. Nevertheless such measures are far from being cure-alls. The needed controls vary from site to site and each must be studied individually.

Joint studies needed

In hillside environments, there is no such thing as an infallible stability forecast; the best any team of men can do is to approximate the probability of slope failure. Even so, the accuracy of the forecast is a function of the knowledge of the *geological structure* of the site, its *lithology, mineralogy,* and *hydrology,* in addition to its engineering variables. In the present state of knowledge the nearest approach to a correct solution comes as a result of a joint and cooperative study of the questionable site, large or small, by the foundation engineer and the engineering geologist, for only through such joint study can all the variables be evaluated.

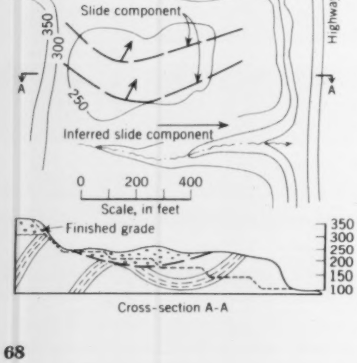
As applied sciences, both these professions are in their infancy; both have been cursed by insulation from one another on both the academic and the professional level. In only a few institutions of higher learning[5] are the geological "engineers" (or engineering geologists) required to pursue any engineering disciplines other than plane surveying. Even more sparse are the civil engineering departments requiring their majors to study elementary physical geology, much less the minimum fundamentals of structural geology, petrology and mineralogy. It is not uncommon to see a geologist who may not understand such terms as "relative compaction" or "factor of safety," attempting to convey ideas to a foundation engineer who cannot differentiate between a sedimentary and a metamorphic rock or understand the simplest geological map.

The focal point of attack on such a situation must be at the educational level, with immediate strengthening of curricula after conferences between engineering and geological faculties. The "liberal arts" geologist is at a terrible disadvantage when, without a modicum of engineering training, he finds himself in a strange discipline requiring close liaison with engineers. Conversely, the young civil engineer looking forward to a career in foundation engineering is but half trained unless he has been adequately grounded in the fundamentals of applied geology.

Why, in most hillside stability problems, is it necessary to have this correlation between two professions before conclusions can be accepted as valid?

The basic tool of the foundation engineer is soil mechanics, wherein "soil" may be thought of as a natural aggregate of mineral grains that can be separated by such gentle mechanical means as agitation in water.[6] This definition, generally the basis for soil mechanics calculations, fits many types of sedimentary rocks, but not all hills and slopes are composed of such materials and the laboratory methods used for "soils," as defined above, are not applicable. Catastrophic landsliding is not uncommon in such strongly cohesive rocks as limestones and marbles,[7] cemented sandstones, and many kinds of igneous and metamorphic rocks.[8,9]

FIG. 1. A casual examination of this site before grading indicated that failure was most likely to occur toward the highway. Later a more thorough study showed that movement would be in the direction of the canyon instead.



The science of geology[10] treats of the origin, history, composition and structure of the earth. A specialized branch of the science, *engineering geology*, applies geologic data, field techniques and principles to the study of rocks, soils and ground water for the purpose of assuring that geologic variables affecting design and construction will be recognized by the engineer. Like the petroleum and mining geologist, the engineering geologist is a specialist in a restricted field.

It is the duty of this specialized geologist to determine the inherent geologic structural characteristics of the foundation rocks beneath the soil mantle or proposed grading in advance of soil mechanics studies. Since stability samples are usually recovered by drilling or boring, it is a gamble with fate and funds to spot such drill sites at random or on the basis of accessibility, roads or what-not, rather than at locations most likely to reveal geologic information of maximum value. Yet random location of drill sites, with complete disregard of geology, is more frequent than might be supposed.

Project costs are frequently reduced when the geologist and the foundation engineer cooperate in determining an adequate field program, including the drill-hole layout. A realization of the need for this fundamental teamwork is slowly gaining momentum against a general apathy. It is required in only a few jurisdictions under certain circumstances, yet slope failures continue to accelerate in hillside environments.

The public, and surprisingly many engineers, tend to overemphasize the load the proposed structure will exert on a fill, rather than to properly consider the load the fill imposes on the foundation rock. Taking a rough estimate of 3,000 lb per cu yd for the fill and a residence with a plan area of 2,000 sq ft, it will be found that roughly each 2 ft of fill depth beneath the house weighs as much as the house itself. Fills in hillside subdivisions are now planned with maximum depths of 200 ft, or roughly 100 times the weight of such a residence. Generally speaking then, a residence with extensive landscaping, appurtenant structures and even a swimming pool, exerts but a small part of the load that is imposed on the foundation rock. Small wonder that the geological structure of such foundation rock should occupy a prominent place in the thinking of the foundation engineer.

The following examples, taken from actual case histories, illustrate how a failure to evaluate subsurface geology can completely negate foundation engineering conclusions based on standard field and laboratory practice.

Example 1. In Fig. 1 an ancient, stabilized landslide mass in folded sediments is capped by younger and more resistant conglomerates and sandstones. The grading plan for a subdivision contemplated stripping some 800,000 cu yd to form a terraced profile. Issuance of grading permits and final approval by the government agency involved was contingent on favorable joint findings of geologists and foundation engineers. A casual engineering examination of the site before grading led to the inference that failure was most likely to occur toward the highway.

Large-scale geological stadia mapping, followed by a mutually approved drill campaign, clearly showed on the geological sections that the ancient slip surfaces most likely to be reactivated in event of failure, would result in a component of movement toward the canyon instead of toward the highway. The stability calculations, outlook, grading and drainage plans were adjusted accordingly.

Example 2. This example, Fig. 2, shows a typical oversimplification of the problem of bedding. The mature topography, sculptured in fissile shales, had a poor stability record because of frequent dip-slips. A proposed subdivision plan, prepared without adequate geologic study, was vetoed by the government agency involved because it called for cuts at "B" (Fig. 2). Excavation was finally permitted at "G" because it was felt that failure by slippage along a bedding plane could not occur if slopes were held to 1 vertical on 1½ horizontal or flatter. If the beds dip into the hill, failure should not occur, or so it was believed. Shear and other physical laboratory tests showed a suitable factor of safety. Nevertheless, subsequent geological mapping made only after a costly slide at point "G," showed a highly brecciated and gougy fault awaiting only undercutting by a bulldozer to allow about $200,000 in property to take the fateful slide down its foot wall. The taxpayers, the subdivider, the contractor and the "soils laboratory" involved, are all defendants.

Example 3. This is an example of a classic failure of a fill that followed all the code rules and regulations but ignored the variables imposed by nature. See Fig. 3. The grading plan ignored bedrock geology, but shear, cohesion, and tests of bearing value showed a factor of safety of 2.0 against

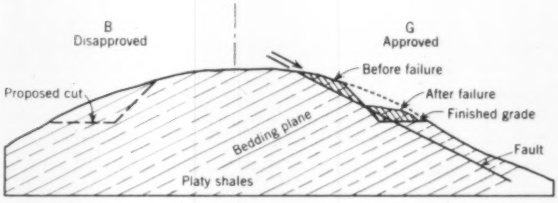


FIG. 2. This figure shows a typical oversimplification of the problem of bedding. Physical laboratory tests showed a suitable factor of safety for a cut at "G" at this site. However, a brecciated and gougy fault caused about $200,000 worth of property to take a fateful slide down its footwall.

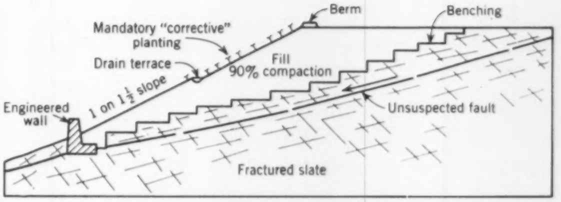


FIG. 3. Here fill and grading plans followed all the code rules, but a dip-slip along a break in the slatey bedrock caused trouble. Break was revealed by subsequent geological mapping, done for preparation of evidence in the inevitable lawsuit and insurance subrogation proceedings.

a permissible minimum of 1.5. Fill was compacted to 90 percent minimum, sloped at 1 vertical on 1½ horizontal, terraced with paved drains for erosion control, "correctively planted," and the subgrade terraced before emplacement. Unforeseen was a dip-slip along an undetected break in the slatey bedrock. This was revealed during the subsequent geological mapping for preparation of evidence for the inevitable lawsuit and insurance subrogation proceedings.

Basic rules

There is an ideal chronology for slope stability studies, and the basic rules should be followed in sequence so far as conditions permit. This check list is suggested for the guidance of financial institutions, subdividers, contractors and engineers charged with responsibility for the control of earthwork stability.

1. *Check* whether the proposed grading or construction is wholly or in part located in a hillside, seacliff, wave terrace, or narrow valley environment, or against the base of hills or mountains. Check the structural geology by geological reconnaissance *before* land is purchased or elaborate tract and grading plans are prepared.

2. *Check,* provided the geological reconnaissance is favorable, the stability characteristics as determined by a team composed of: (1) an engineering geologist trained and experienced in this specialty, adequately supported by basic surveying instrumentation and personnel; and (2) a foundation engineer who is a civil engineer specifically trained and experienced in this specialty, supported by requisite field and laboratory equipment and personnel.

3. *Check* the educational and experience backgrounds of the consultants. Talk to other clients and public officials. Unearth any reference you can. "Registration" or an advanced degree alone is no guarantee of professional competence. Until registration laws and curricula are strengthened, this is a fundamental consideration.

4. *Check* to see that the drill-hole pattern, if drilling is required, is jointly approved before penetration, by both the geologist and the foundation engineer, and that cores and cuttings are logged by both.

5. *Check* to be certain that large-scale areal geology maps and cross sections, prepared preferably by methods as accurate as stadia surveying, are submitted both to the foundation engineer and to the control agency, and that geological conclusions are clearly stated with some statistical estimate of the stability of the rock structures.

6. *Check* to ascertain that the foundation engineering conclusions consider both geological findings and local codes. Code compliance alone does not guarantee protection.

7. *Check* to see that the grading plan is prepared only after the findings of the geologist and foundation engineer have been made, not vice versa. Plan modifications cost money.

8. *Check* the management and emplacement of fills predicted on joint decisions of both design and foundation engineers, with due consideration of structural geological characteristics of subfill foundation rocks. Large-scale field shear tests should be made to correlate compaction with fill design. The prototype field test should be witnessed by the government agent, geologist and foundation engineer.

9. *Check* and follow up both geologist and foundation engineer to be sure that periodic field inspections are made during grading. Unexpected revelations may require modification of the original grading plan.[8]

10. *Check* the architect to be certain that architectural designs and specifications encompass provisions dictated by the stability characteristics and structural geology of the site. The plot plan should fit the stability environment, not vice versa.

11. *Check* the relationship of flora to "skin" stability by adopting the recommendations of a landscape architect following a conference with the geologist and the foundation engineer. Do not depend upon gardeners, nurserymen, etc.

12. *Check* the possible effects of introducing subsurface moisture into bedrocks from cesspools, seepage pits and the like. Most codes are passé in this respect, made still more obsolete by such modern innovations as the garbage grinder. Both the foundation engineer and the geologist should be fully informed of the anticipated subsurface hydrologic input; it frequently affects bedrock stability.

The writers express sincere thanks for able and constructive criticism of this article by John T. McGill, Geologist, U. S. Geological Survey; L. T. Evans, consulting foundation engineer; and R. Bruce Lockwood, consulting geologist, all of Los Angeles, Calif.

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M-m tables for deflection calculations

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Calculation of deflections by the method of virtual work has been the subject of two recent articles, one by Elwood Heinz, A. M. ASCE, in the November 1958 issue (vol. p. 853) and one by Prof. Charles W. Cunningham, F. ASCE, in the March 1959 issue (vol. p. 175). Both articles deal with the numerical work involved in integrating the product of two functions. The procedures proposed are limited in scope as far as they presuppose at least one function to be linear and they appear to be laborious considering that tables exist which cover a wide range of moment diagram combinations. The writer's previous experience that these tables are unknown to the majority of North American engineers has been confirmed by the articles mentioned and he wishes therefore to present and illustrate the use of one of the more elaborate *M-m* tables.

The accompanying table has been copied and adapted from a publication of the University of Munich, Germany. A table of similar nature, but less comprehensive, appears in *Theory and Practice of Reinforced Concrete,* by C. W. Dunham, F. ASCE (McGraw Hill, Inc., 1944, page 526).

Example 1. Consider the frame of Mr. Heinz's article shown in the accompanying Fig. 1 (*a*). I = constant, hence $L' = L$.

As was pointed out by Prof. L. C. Maugh, F. ASCE, in the January 1959 issue (vol. p. 33), the *m*-diagram need only be taken on a free cantilever. See Fig. 1 (*a*) and (*b*).

With the moment diagrams as shown, Col. 2 of the *M-m* tables gives

$$EI_c\delta = \frac{1}{6}20\,(2 \times 75.2 + 9.2)\,20$$
$$= 10{,}640$$

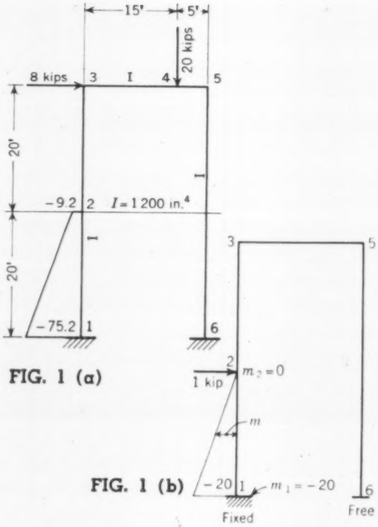
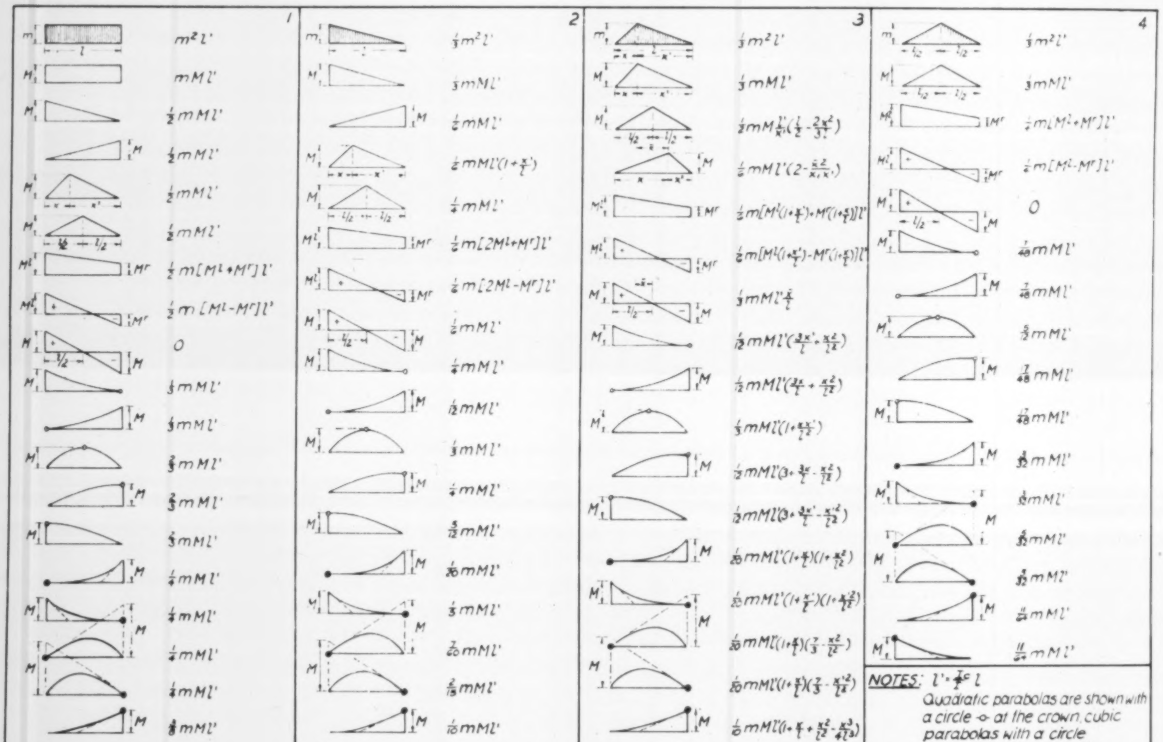


FIG. 1 (a)

FIG. 1 (b)



1	2	3	4
$m^2 l'$	$\frac{1}{3}m^2 l'$	$\frac{1}{3}m^2 l'$	$\frac{1}{3}m^2 l'$
mMl'	$\frac{1}{3}mMl'$	$\frac{1}{3}mMl'$	$\frac{1}{3}mMl'$
$\frac{1}{2}mMl'$	$\frac{1}{6}mMl'$	$\frac{1}{2}mM\frac{l'}{x'}(\frac{l}{2}-\frac{2x^2}{3l})$	$\frac{1}{4}m[M^l+M^r]l'$
$\frac{1}{2}mMl'$	$\frac{1}{6}mMl'(1+\frac{x'}{l})$	$\frac{1}{6}mMl'(2-\frac{\bar{x}^2}{x\,x'})$	$\frac{1}{4}m[M^l-M^r]l'$
$\frac{1}{2}mMl'$	$\frac{1}{4}mMl'$	$\frac{1}{6}m[M^l(1+\frac{x'}{l})+M^r(1+\frac{x}{l})]l'$	0
$\frac{1}{2}mMl'$	$\frac{1}{6}m[2M^l+M^r]l'$	$\frac{1}{6}m[M^l(1+\frac{x'}{l})-M^r(1+\frac{x}{l})]l'$	$\frac{7}{48}mMl'$
$\frac{1}{2}m[M^l+M^r]l'$	$\frac{1}{6}m[2M^l-M^r]l'$	$\frac{1}{3}mMl'\frac{\bar{x}}{l}$	$\frac{7}{48}mMl'$
$\frac{1}{2}m[M^l-M^r]l'$	$\frac{1}{6}mMl'$	$\frac{1}{12}mMl'(\frac{3x'}{l}+\frac{x^2}{l^2})$	$\frac{5}{12}mMl'$
0	$\frac{1}{4}mMl'$	$\frac{1}{12}mMl'(\frac{3x}{l}+\frac{x^2}{l^2})$	$\frac{17}{48}mMl'$
$\frac{1}{3}mMl'$	$\frac{1}{12}mMl'$	$\frac{1}{3}mMl'(1+\frac{xx'}{l^2})$	$\frac{17}{48}mMl'$
$\frac{1}{3}mMl'$	$\frac{1}{3}mMl'$	$\frac{1}{12}mMl'(3+\frac{3x}{l}-\frac{x^2}{l^2})$	$\frac{3}{32}mMl'$
$\frac{2}{3}mMl'$	$\frac{1}{4}mMl'$	$\frac{1}{12}mMl'(3+\frac{3x'}{l}-\frac{x'^2}{l^2})$	$\frac{3}{32}mMl'$
$\frac{2}{3}mMl'$	$\frac{5}{12}mMl'$	$\frac{1}{20}mMl'(1+\frac{x}{l})(1+\frac{x^2}{l^2})$	$\frac{5}{32}mMl'$
$\frac{2}{3}mMl'$	$\frac{1}{20}mMl'$	$\frac{1}{20}mMl'(1+\frac{x'}{l})(1+\frac{x'^2}{l^2})$	$\frac{5}{32}mMl'$
$\frac{1}{4}mMl'$	$\frac{1}{5}mMl'$	$\frac{1}{20}mMl'(1+\frac{x}{l})(\frac{7}{3}-\frac{x^2}{l^2})$	$\frac{11}{64}mMl'$
$\frac{1}{4}mMl'$	$\frac{7}{60}mMl'$	$\frac{1}{20}mMl'(1+\frac{x'}{l})(\frac{7}{3}-\frac{x'^2}{l^2})$	$\frac{11}{64}mMl'$
$\frac{1}{4}mMl'$	$\frac{2}{15}mMl'$	$\frac{1}{10}mMl'(1+\frac{x}{l}+\frac{x^2}{l^2}-\frac{x^3}{4l^3})$	
$\frac{1}{4}mMl'$	$\frac{1}{10}mMl'$	$\frac{1}{10}mMl'(1+\frac{x'}{l}+\frac{x'^2}{l^2}-\frac{x'^3}{4l^3})$	
$\frac{3}{8}mMl'$	$\frac{11}{40}mMl'$		
$\frac{3}{8}mMl'$			

NOTES: $l' = \frac{I_c}{I}\,l$

Quadratic parabolas are shown with a circle ○ at the crown, cubic parabolas with a circle ● at the point where the triangular load is zero.

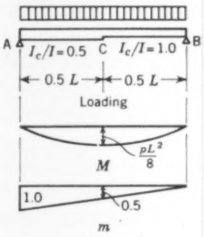

A
$I_c/I = 0.5$
C
$I_c/I = 1.0$
B
0.5 L
0.5 L
Loading
M
$\frac{pL^2}{8}$
1.0
0.5
m

FIG. 2

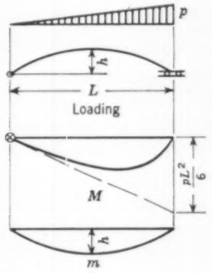

p
h
L
Loading
M
$\frac{pL^2}{6}$
h
m

FIG. 3

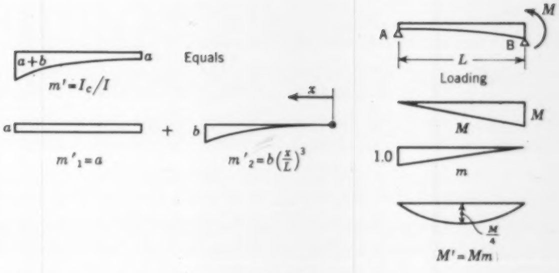

a+b
a
$m' = I_c/I$
Equals
a
+
b
x
$m'_1 = a$
$m'_2 = b\left(\frac{x}{L}\right)^3$
A
B
M
L
Loading
M
M
1.0
m
$\frac{M}{4}$
$M' = Mm$

FIG. 4

Example 2. Find the rotation α of point A of the simple beam of varying I as shown, due to a uniform load p. See Fig. 2. Because of the discontinuity of I, two distinct operations are necessary.

From A to C, $L' = 0.5 \times 0.5 \;\; L = 0.25\, L$

$$\text{Column 5 gives } EI_c\,\alpha_{AC} = \frac{1}{12}\,\frac{p\,L^2}{8}\,(3 + 5 \times 0.5)\; 0.25\, L = \frac{5.5}{384}\,p\,L^3$$

From C to B, $L' = 1 \times 0.5\, L = 0.5\, L$

Column 2 gives

$$EI_c\,\alpha_{CB} = \frac{5}{12}\,\frac{p\,L^2}{8}\;0.5 \times 0.5\, L = \frac{5}{384}\,p\,L^3$$

and by summation

$$EI_c\,\alpha = \frac{10.5}{384}\;p\,L^3 = \frac{7}{256}\;p\,L^3$$

Example 3. Find the horizontal displacement of the free end of a parabolic arch under trangular loading with $I_c = I \cos \phi$ and disregard rib shortening. See Fig. 3.

Column 9 gives

$$EI_c\,\delta = \frac{1}{5}\;h\;\frac{p\,L^2}{6}\;L = \frac{h\,p\,L^3}{30}$$

Example 4. Assume a haunched girder of which the I_c/I distribution can be approximated by a cubic parabola as shown in Fig. 4. Find the rotation at A due to a moment M at B. The M and m diagrams in the table represent algebraic functions, not necessarily bending moments. It is possible therefore to substitute $m' = I_c/I$ and $M' = M \times m$.

Furthermore the new function m' may be represented by the sum of its component parts, m'_1 and m'_2, as illustrated so that

$$\int M'm' = \int M'm'_1 + \int M'm^2$$

Column 1 gives

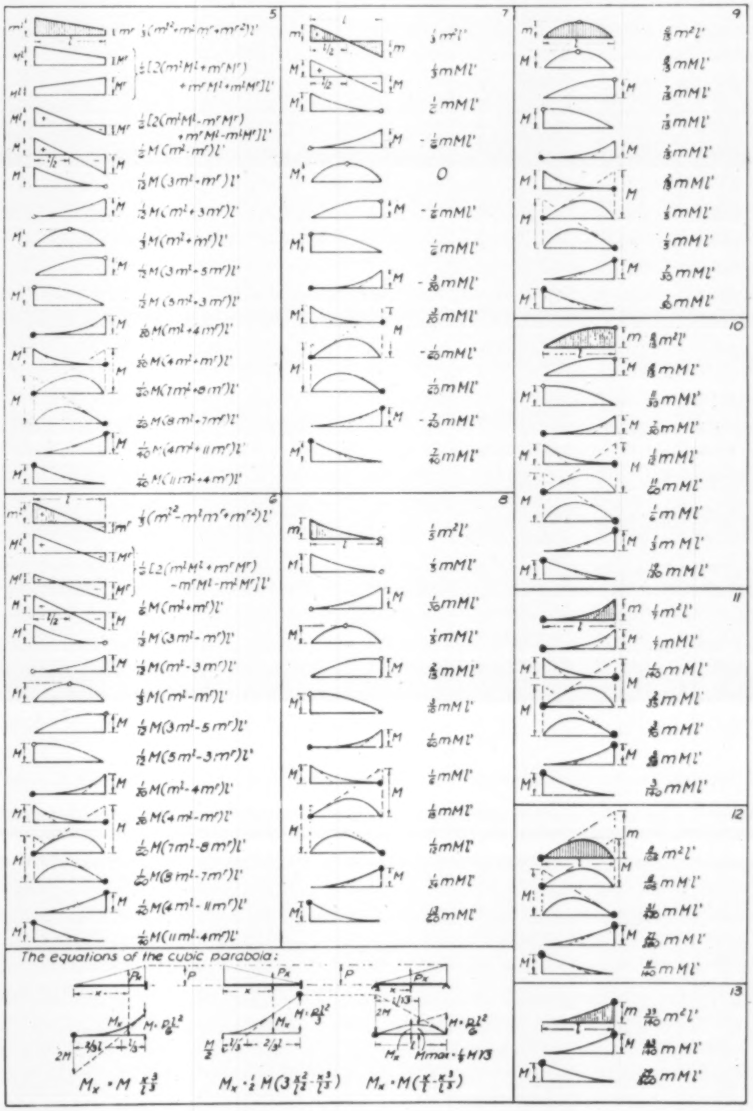
$$EI_c\,\alpha_1 = \frac{2}{3}\;a\;\frac{M}{4}\;L = \frac{1}{6}\;a\,M\,L$$

Column 9 gives

$$EI_c\,\alpha_2 = \frac{2}{15}\,\frac{M}{4}\;b\;L = \frac{1}{30}\;\;b\;M\;L$$

and by summation,

$$EI_c\,\alpha = M\;L\;(a/6 + b/30).$$


5
m^l
m^r
l'
M^l
M^r
$\frac{1}{3}(m^{l2}+m^lm^r+m^{r2})l'$
$\frac{1}{6}[2(m^lM^l+m^rM^r)+m^rM^l+m^lM^r]l'$
$\frac{1}{6}[2(m^lM^l-m^rM^r)+m^rM^l-m^lM^r]l'$
$\frac{1}{6}M(m^l-m^r)l'$
$\frac{1}{12}M(3m^l+m^r)l'$
$\frac{1}{12}M(m^l+3m^r)l'$
$\frac{1}{3}M(m^l+m^r)l'$
$\frac{1}{12}M(3m^l+5m^r)l'$
$\frac{1}{12}M(5m^l+3m^r)l'$
$\frac{1}{20}M(m^l+4m^r)l'$
$\frac{1}{20}M(4m^l+m^r)l'$
$\frac{1}{60}M(7m^l+8m^r)l'$
$\frac{1}{60}M(8m^l+7m^r)l'$
$\frac{1}{40}M(4m^l+11m^r)l'$
$\frac{1}{40}M(11m^l+4m^r)l'$
6
$\frac{1}{3}(m^{l2}-m^lm^r+m^{r2})l'$
$\frac{1}{6}[2(m^lM^l+m^rM^r)-m^rM^l-m^lM^r]l'$
$\frac{1}{6}M(m^l+m^r)l'$
$\frac{1}{12}M(3m^l-m^r)l'$
$\frac{1}{12}M(m^l-3m^r)l'$
$\frac{1}{3}M(m^l-m^r)l'$
$\frac{1}{12}M(3m^l-5m^r)l'$
$\frac{1}{12}M(5m^l-3m^r)l'$
$\frac{1}{20}M(m^l-4m^r)l'$
$\frac{1}{20}M(4m^l-m^r)l'$
$\frac{1}{60}M(7m^l-8m^r)l'$
$\frac{1}{60}M(8m^l-7m^r)l'$
$\frac{1}{40}M(4m^l-11m^r)l'$
$\frac{1}{40}M(11m^l-4m^r)l'$
7
$\frac{1}{3}m^2l'$
$\frac{1}{3}mMl'$
$\frac{1}{6}mMl'$
$-\frac{1}{6}mMl'$
0
$-\frac{1}{6}mMl'$
$\frac{1}{6}mMl'$
$-\frac{3}{20}mMl'$
$\frac{3}{20}mMl'$
$-\frac{1}{60}mMl'$
$\frac{1}{60}mMl'$
$-\frac{7}{40}mMl'$
$\frac{7}{40}mMl'$
8
$\frac{1}{5}m^2l'$
$\frac{1}{5}mMl'$
$\frac{1}{30}mMl'$
$\frac{1}{5}mMl'$
$\frac{2}{15}mMl'$
$\frac{3}{10}mMl'$
$\frac{1}{60}mMl'$
$\frac{1}{6}mMl'$
$\frac{1}{15}mMl'$
$\frac{1}{12}mMl'$
$\frac{1}{24}mMl'$
$\frac{13}{60}mMl'$
9
$\frac{8}{15}m^2l'$
$\frac{8}{15}mMl'$
$\frac{7}{15}mMl'$
$\frac{7}{15}mMl'$
$\frac{2}{15}mMl'$
$\frac{2}{15}mMl'$
$\frac{1}{5}mMl'$
$\frac{1}{5}mMl'$
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$\frac{7}{30}mMl'$
10
$\frac{8}{15}m^2l'$
$\frac{8}{15}mMl'$
$\frac{11}{30}mMl'$
$\frac{7}{30}mMl'$
$\frac{1}{12}mMl'$
$\frac{11}{60}mMl'$
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$\frac{13}{30}mMl'$
11
$\frac{1}{7}m^2l'$
$\frac{1}{7}mMl'$
$\frac{1}{140}mMl'$
$\frac{2}{35}mMl'$
$\frac{3}{70}mMl'$
$\frac{3}{28}mMl'$
$\frac{3}{140}mMl'$
12
$\frac{8}{105}m^2l'$
$\frac{8}{105}mMl'$
$\frac{31}{420}mMl'$
$\frac{27}{280}mMl'$
$\frac{11}{140}mMl'$
13
$\frac{33}{140}m^2l'$
$\frac{43}{140}mMl'$
$\frac{27}{280}mMl'$
The equations of the cubic parabola:
p_x
x
p
M_x
$M = \frac{pl^2}{6}$
2M
$2/3\,l$
$l/3$
$M_x = M\,\frac{x^3}{l^3}$
$M = \frac{pl^2}{3}$
$\frac{M}{2}$
$l/3$
$2/3\,l$
$M_x = \frac{1}{2}M\left(3\frac{x^2}{l^2}-\frac{x^3}{l^3}\right)$
$l/\sqrt{3}$
2M
$M = \frac{pl^2}{6}$
l
$M_{max} = \frac{1}{3}M\sqrt{3}$
$M_x = M\left(\frac{x}{l}-\frac{x^3}{l^3}\right)$

Computing prestressed concrete composite sections

HANS R. SCHAEFFER, M. ASCE, Civil Engineer, John Sardis & Associates, San Francisco, Calif.

The designer of prestressed concrete composite sections, composed of precast and poured-in-place parts, is confronted with a tedious determination of the required prestress forces and stresses for various sections and loading conditions. To facilitate these calculations, the following method of tabular computation is proposed.

Notation:

A_p = area of precast concrete section, in.^{2}

c.g.p. = center of gravity of precast section

c.g.s. = center of gravity of prestressed steel

D.L. No. 1 = dead load acting on precast section, that is, girder load plus poured-in-place slab

D.L. No. 2 = dead load acting on composite section, such as a sidewalk

F_f = final stress in extreme fiber

F_i = inital stress in extreme fiber

F_{pr} = stress due to prestress force, P

G.L. = girder load

L.L. = live load including impact

M = moment, ft-kips

M'_p = moment due to P = 1 kip, ft-kips

P = prestress force, kips

P_f = final prestress force after losses, kips

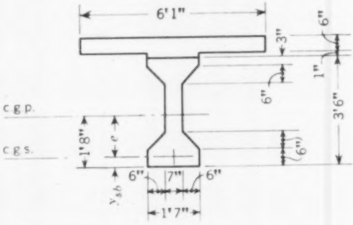
P_i = initial acting prestress force at time of prestressing

S_c = section modulus of composite section, in.^{3}

S_p = section modulus of precast section, in.^{3}

T.L. = total vertical load

For further notations see sketch.



In theory:

$$F_f = \frac{P_f}{A_p} \pm \sum \frac{M}{S} \quad \text{. . . . . (1)}$$

with $M'_p = 1 \times e$

$$F_{pr} = \left(\frac{1{,}000}{A_p} \pm \frac{M'_p}{S_p} \right) P \quad \text{. . . . . (2)}$$

$$F_f = \left[\left(\frac{1{,}000}{A_p} \pm \frac{M'_p}{S_p} \right) P_i \right] + \frac{M_{\text{D. L. No. 1}}}{S_p} + \frac{M_{\text{D. L. No. 2}}}{S_c} + \frac{M_{\text{L. L.}}}{S_c} \quad . \text{ (3)}$$

$$F_i = \left[\left(\frac{1{,}000}{A_p} \pm \frac{M'_p}{S_p} \right) \text{P}_i \right] + \frac{M_{\text{G. L.}}}{S_p} . \text{ (4)}$$

The procedure is to:

1. Tabulate

$$S_p \times \frac{1}{12{,}000},\ S_c \times \frac{1}{12{,}000},\ \text{and } M.$$

2. Compute stresses at top and bottom of precast girder due to vertical loads. The girder load and D. L. No. 1 are acting on the precast section, D.L. No. 2 and L.L. are acting on the composite section. (Table I, Cols. 3 to 7)

3. Choose two or three possible positions for the center of gravity of the prestressed steel at center of span. Record y_{sb} and e. $M'_p = 1 \times e$. Two values for this are given in Table I.

4. Compute stresses for P = 1.00 kip (Eq. 2), (Cols. 8, 9, 10).

5. Choose P_f. Values differ for different locations of prestressed steel.

6. Compute stress due to final prestress force (Col. 11).

7. Compute stress due to initial prestress force (Col. 12).

8. Add stresses due to T.L. and P_f for final total stresses (Eq. 3), (Col. 13).

9. Add stresses due to girder load and P_i for initial stresses (Eq. 4), (Col. 14).

Example

The method is presented for an interior girder section of a highway bridge of 74-ft span. The girder is a 3-ft 6-in. standard I-girder as proposed by the State of California, Division of Highways.

The computation of section properties as well as of the moments is not shown. The results are given in Table I and Fig. 1. The values used are:

For the precast concrete section:

Area, A_p = 474 in.^{2}

Section modulus, at top, S_{pt} = 4,320 in.^{3}

Section modulus, at bottom, S_{pb} = 4,750 in.^{3}

For the composite section:

Section modulus, at top, S_{ct} = 27,100 in.^{3}

Section modulus, at bottom, S_{cb} = 7,700 in.^{3}

Prestress forces and stresses are com-

TABLE I. Computation for the example

(Column numbers in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	S_p in.^{4}	S_c in.^{4}	VERTICAL LOADS				
	$\times \frac{1}{12{,}000}$	$\times \frac{1}{12{,}000}$	G.L.	D.L.No.1	D.L.No.2	L.L.	T.L.
			M/S_p		M/S_c		(4) + (5) + (6)
Moment, ft-kips	....	....	333	705	173	710	....
Top stress, psi	0.360	2.260	925	1,958	76	314	2,348
Bottom stress, psi	0.395	0.641	– 844	– 1,785	– 270	– 1,108	– 3,163

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	PRESTRESSING STRESSES					TOTAL STRESSES	
	For P = 1.00 kip			P_f kips	P_i kips	Final	Initial
	$1{,}000/A_p$	M'_p/S_p	(8) + (9)	$P_f \times$ (10)	(11) × 1.23	(7) + (11)	(3) + (12)
Where y_{sb} = 3 in., e = 1.42 ft, P_f = 560 kips:							
Top stress, psi	2.11	– 3.95	– 1.84	– 1,030	– 1,268	1,318	– 343
Bottom stress, psi	2.11	3.60	5.71	3,200	3,940	37	3,096
Where y_{sb} = 6 in., e = 1.17 ft, P_f = 630 kips:							
Top stress, psi	2.11	– 3.25	– 1.14	– 718	– 884	1,630	41
Bottom stress, psi	2.11	2.96	5.07	3,200	3,940	37	3,096

puted at center of girder for two locations of the center of gravity of prestressed steel. This procedure is proposed for use whenever the method of prestressing is not known at the time of design and the design has to meet the requirements of different prestressing systems. In general, forces and stresses for two to four different locations of prestressing forces should be computed. The design drawings would give the final prestress forces for the various locations of prestressing steel and the required concrete stresses at the time of transfer of the prestressing force and at 28 days.

The initial stresses were computed for post-tensioning. The final prestress force has been increased by 23 percent to accommodate for losses due to shrinkage, creep and sequence stressing. In general, the initial stresses in a post-tensioned system will govern the design.

The outlined method gives the designer an easy-to-read computation in which he can follow the influence of any one load condition.

THE READERS WRITE

Some comments on the format of "Civil Engineering"

To the Editor: Please—can't you do something to stop the "slickerization" of Civil Engineering? I refer to the mixing up of the news pages with the technical articles and the running of titles of articles across two facing pages so that when pages are torn out for filing the subject of the article cannot be determined from the top page.

I am quite certain that I speak for many members when I lay this plea on your doorstep.

Robert F. Legget, F.ASCE
Director, Div. of Bldg. Research
National Research Council
Ottawa, Canada

Editor's Note: *Part of ASCE News has been placed with the technical articles in an effort to increase interest in the professional activities of the Society. Do you like it? Do you now read more ASCE News? Is it more difficult to find things in* Civil Engineering? *Thoughtful comments on the format and content of* Civil Engineering *always are welcome.*

Leakproof concrete tanks for aviation fuel

To the editor: The article, "Leakproof Concrete Tanks for Aviation Fuel," in the April issue, p. 44, is of considerable interest and its authors, John J. Closner and Mark M. Porat, are to be commended for their initiative in writing it. Two points, however, should be clarified:

1. The ultimate compressive strength of the concrete was 5,000 psi for the walls and 3,000 psi for the roof and floor slabs.
2. The prime design engineer for the facility—consisting of excavation and backfill, fuel storage tanks, pipelines, pumping station and loading dock—was Barnard and Ancira of Dallas, Tex. The twelve underground tanks were designed by the engineering department of Herrick Iron Works under the direction of J. D. Naillon, who at that time was Chief Engineer for Herrick Iron Works. Mark M. Porat of the Preload Company served as structural consultant for the concrete design.

J. D. Naillon, M. ASCE
Consulting Engineer
Walnut Creek, Calif.

Large-size compression steel used in 1903

To the Editor: The following comments are prompted by the article, "Extra-Large Bars for Reinforced Concrete Columns," by Vernon E. Swanson, F. ASCE, in the February issue, p. 82.

Some interesting blueprints came to light a few days ago during the cleaning out of some of our files. They are concrete drawings prepared in 1902 by Elzner & Anderson, architects, for what was at that time a remarkable building—the 16-story reinforced-concrete Ingalls Building in Cincinnati, completed in 1903.

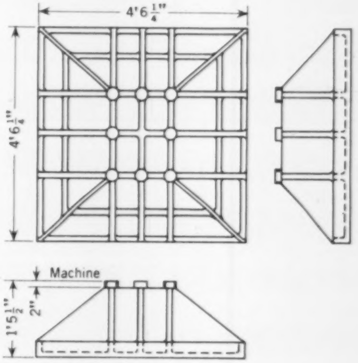
Ludwig Eid, a German-born engineer, was a member of the advisory board on which the owner, W. E. Ingalls, relied for endorsement of the idea of such a structure and approval of the design details. Mr. Eid had kept in close touch with foreign practice in the developing art of reinforced concrete construction and was a very early licensee under the Hennebique patents. He forsook the field of structural steel to engage in this new industry.

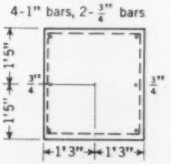
There was a family connection between the designing architectural firm and the contractors, Ferro Concrete Construction Company, which greatly facilitated the development of the project, with Henry Hooper, of Elzner & Anderson, as designing engineer. The accompanying sketches are copied from the blueprints to show the "armoring" of typical columns and a typical cast-iron base plate with machined bosses for seating the milled ends of the "compression" bars in the bottom story.

These bars were made to extend through one story in the basement and through two stories where used above. They were reduced in section successively from 3$\frac{15}{16}$ in. in the basement to ¾ in. in the fourth, fifth, and seventh stories. Above these stories no compression bars whatever were used, the entire load being taken by the concrete. The ends of these compression bars were milled perfectly square and connected by pipe sleeves from 12 to 16 in. long, of slightly larger diameter than the bars, filled in with cement grout.

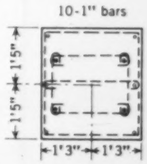
The resistance to bending due to wind was provided by twisted steel bars extending approximately from middle to middle of story heights, with the ends at joints lapped by short lengths of ¼-in. bars wired to them. These wind bars varied from as many as sixteen 1-in. bars in the first story to four ½-in. bars in the upper stories, and were placed within the ¼-in. rectangular hoops.

Hunter W. Hanly, F.ASCE
Hanly & Young, Civil and Structural Engrs.
Cincinnati, Ohio

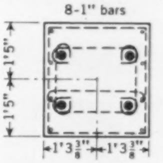




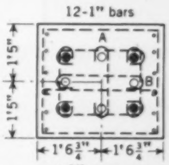
From 10th fl. to 11th fl.



From 9th fl. to 10th fl.



Cols. 9, 12, 13
4-3$\frac{5}{16}$" bars
Cols. 10, 11
4-3" bars
From 4th fl. to 5th fl.



4-3$\frac{1}{2}$" bars each
Cols. 9, 12
2-3$\frac{1}{4}$" bars A
2-3$\frac{1}{8}$" bars B
Cols. 10, 11
2-3$\frac{3}{8}$" bars A
Col. 13
2-3$\frac{3}{8}$" bars A
2-3" bars B
From basement to 1st fl.

Missouri School of Mines Dedicates New C. E. Building

ASCE officers, past and present, were on hand for recent dedication of the Missouri School of Mines new $1,000,000 civil engineering building. Reading left to right are James A. Finch, Jr., chairman, Board of Curators; ASCE President Frank A. Marston; Dean Curtis L. Wilson, Missouri School of Mines; ASCE Past President Enoch R. Needles, distinguished alumnus of the School of Mines and principal speaker at the dedication; Prof. E. W. Carlton, chairman, Civil Engineering Department; William H. Wisely, Executive Secretary of ASCE; and Dr. Elmer Ellis, president of the University of Missouri. At the close of the program Mr. Marston addressed a joint dinner meeting of the Missouri School of Mines Student Chapter and the Mid-Missouri Section. Of special interest in the new structure, largest on the campus, are a Computer Center and the Needles Conference Room, which was furnished by Mr. Needles.

Engineering Leaders to Re-examine Civil Curricula at July Meeting

Engineering educators from all parts of the United States will gather at the University of Michigan, July 6-8, for what has been described as a vital conference on civil engineering education curricula. The project is co-sponsored by ASCE and the American Society for Engineering Education.

Deans and heads of civil engineering departments in 138 colleges, universities, and institutions with curricula in civil engineering accredited by the Engineers Council for Professional Development have been invited to attend the conference on an expense-paid basis. More than 100 other engineering educators are expected to attend.

The conference is being financed by a grant from the National Science Foundation. Last December, The Cooper Union received a grant of $43,410 from the National Science Foundation to support a project study of the scope and content of undergraduate curricula in civil engineering. Two preliminary planning conferences were held at Cooper Union's Green Engineering Camp at Ringwood, N. J., at which the program for the Ann Arbor conference was developed. The planning meetings were attended by outstanding leaders in the profession as well as civil engineering educators.

The study underway was proposed at a meeting of engineering educators held in the summer of 1959 under Cooper Union sponsorship. At that time the group agreed that civil engineering education should be re-examined in order to reverse decreasing enrollments and to attract better qualified students into the field. The recommendations made by the group resulted in the grant from the National Science Foundation.

Expansion in civil engineering curricula, perhaps with more emphasis on the study of humanities, and lengthening the period of study before degrees are granted, are among the subjects to be considered at the conference. A report of a study group at one of the planning meetings said: "In four years, it is impractical to expect engineering college men to be fully capable in all the fields of civil engineering."

The official delegates are those from the 138 colleges, universities and institutions with accredited civil engineering curricula, one from each school, plus a delegate from the University of California, Los Angeles. The 139 delegates will be constituted as voting members of the July conference. A form to facilitate enrollment has been provided on page 150.

The program for the forthcoming three-day conference follows.

Wednesday, July 6
12:00 noon *Luncheon*

Speaker: Felix Wallace, Cooper Union, "Background and Objectives of the Conference on Civil Engineering Education"

1:30 p.m. *Session I*—The Basis of Civil Engineering Education

Presiding: Lee Johnson, Tulane University

Keynote ....N. M. Newmark
The Scope of Civil Engineering ....J. B. Wilbur
  Prepared Discussion ....John Logan
The Scientific Base for Civil Engineering ....J. L. Waling
  Prepared Discussion ..J. S. McNown
The Distinction Between Engineering and Science .J. W. Graham
  Prepared Discussion ....M. P. White

Thursday, July 7
9:30 a.m. *Session II*—Proposed Structure of the Undergraduate Curriculum

Presiding: W. P. Kimball, Dartmouth College

The Interchangeable Core ....H. Gray
  Prepared Discussion ...P. F. Chenea
Building on the Interchangeable Core ......H. D. Eberhart
  Prepared Discussion ..E. H. Gaylord

12:00 noon *Luncheon*—
Speaker: Earnest Boyce, University of Michigan, "India"

2:00 p.m. *Session III*—Professional Development

Presiding: B. A. Whisler, Penn. State University

Post Fifth-Year Education ....R. E. Fadum
  Prepared Discussion ..V. L. Streeter
Professional Education During Employment ....J. W. Hubler
  Prepared Discussion ....Mason Lockwood
Impact on the Profession ..F. Edwards
  Prepared Discussion ....Fred Merryfield

Friday, July 8
9:00 a.m. *Session IV*—Aims and Objectives

Presiding: R. E. Stiemke, Georgia Institute of Technology

Long-Range Goals in Civil Engineering Education ..J. E. McKee
  Prepared Discussion ....D. H. Pletta
Summary of Conference ....C. Wandmacher
General Discussion

ASEE Annual Convention

The American Society for Engineering Education will hold its annual convention at Purdue University, June 20-24. Details from Prof. Mark Roberts, Purdue University, Lafayette, Ind.

1960 Nuclear Congress Papers Available

For those who found it impossible to attend the 1960 Nuclear Congress, and to obtain printed copies of papers at the Congress, provision has been made for mail order distribution. These arrangements have been made as a part of the first objective of the Congress, "to provide free exchange of knowledge in the subject area between engineers and scientists and the industry which is dependent upon such information."

The Nuclear Congress, held in New York City's Coliseum, April 4-7, produced new information in a variety of subject areas related to the application of nuclear energy for mankind's benefit. A total of 62 papers were presented in the streamlined technical program. These papers were carefully selected so as not to duplicate any presented during other atomic conferences, and to fill gaps in information currently available.

The following listing includes papers containing information of primary interest to civil engineers. These papers may be ordered by number, or the complete set may be obtained. The price is 50 cents per paper, or $20 for the set. Address all orders to the 1960 Nuclear Congress, 29 West 39th Street, New York 18, N. Y.

Paper 10–"Results of 1959 Nuclear Power Plant Containment Tests" by Alf Kolflat, Sargent and Lundy.

Paper 11–"Review of Shippingport Operations—Site Factors" by John E. Gray, Duquesne Light Co.

Paper 13–"Civil Engineering Aspects of Nuclear Power Plants" by R. W. Kupp and J. C. Tourek, Vitro Engineering Co.

Paper 14–"Sites for Nuclear Power Plants for Large Spanish Utility" by Jamie Mac-Veigh, President, Tecnatom.

Paper 15–"The Army Nuclear Power Program" by Donald G. Williams, Colonel, Corps of Engineers; Chief, Army Nuclear Power Program.

Paper 16–"BuDocks Role in the Development of Nuclear Power for the Navy's Shore Bases" by W. J. Christensen, Commander, CEC, USN, Manager, Atomic Energy and Applied Science Branch, BUDOCKS, Dept. of the Navy.

Paper 18–"Comparative Study of the Natural Uranium Graphite Moderated Gas Cooled Reactors" (U. S., British, French, etc.) by Robert Gibrat, President, Indatom.

Paper 19–"Status of Regulation at the Municipal Level" (protecting public health) by Hanson Blatz, N. Y. C. Health Dept.

Paper 21–"Status of Regulation at Federal Level: Responsibilities of the U. S. Public Health Service" by Francis J. Weber, Chief, Div. of Radiological Health, Dept. of Health, Education and Welfare.

Paper 22–"Current Status of International Regulatory Activities in the Field of Public Health as Related to Atomic Energy and Its Uses in Industry" by A. I. Galagan, International Atomic Energy Adm., United Nations

Paper 27–"Operation and Experimental Use of Battelle Research Reactor" by A. M. Plummer, J. N. Anno, and J. W. Chastain, Jr., Battelle Memorial Inst.

Paper 28–"Operating Experience with In-Pile Loops at ORNL" by J. A. Cox, ORNL

Paper 29–"Construction and Operation of The McMaster Nuclear Reactor" by W. H. Fleming, McMaster Univ.

Paper 30–"Design of a Hot Laboratory for Metallurgical Research in Germany" by W. Stephan, GFKF Inst. Fur Rector—Werkstoffe, Aachen, Germany.

Paper 31–"Applications of Swimming Pool Reactors" by Mrs. J. Libert, Indatom.

Paper 37–"Strontium 90 in Surface Water" by C. P. Straub, L. R. Setter, P. F. Hallbach, and A. S. Goldin, Dept. of Health, Education & Welfare, R. A. Taft Sanitary Eng. Center.

Paper 38–"Continuous Calcination of Aqueous Waste Solutions by Radiant Heat" by R. T. Allemann and P. M. Johnson, General Electric Co.

Paper 39–"Surveillance of a Municipal Water System to Assure Control Radioisotopes—A Study of the Hanford Atomic Products Operation" by Robert L. Junkins, Hanford Atomics Operation, Richland, Wash.

ASCE Membership as of May 9, 1960

Fellows	10,932
Members	15,963
Associate Members	18,161
Affiliates	95
Honorary Members	47
Total	45,198
(May 9, 1959	42,774)

Long-Time Society Employee Honored

On behalf of the Society, President Marston presents a wrist watch to Margaret Maurer in recognition of 25 years of service on the ASCE staff. Miss Maurer joined the staff in 1935 as a secretary, and is now an administrative assistant in the Executive Secretary's office.

Division Doings

Hydraulics Division Conference

A salt water cruise and a mountain trip are additional features of the Ninth National Conference of the Hydraulics Division, to be held in Seattle, Wash., August 17-19.

The mountain trip is a pre-conference all-day guided tour, on August 16, through the Seattle City Light's integrated three-dam hydroelectric project, located in the northern Cascade Mountains near the Canadian border. This trip combines mountain scenery with technical interests, and includes transportation by bus, boat, and inclined railway. Lunch will be served at the project. A salmon barbecue is scheduled for the evening of August 17, the first day of the formal conference. The meal will be served on the beach, following a boat trip through the Chittenden Locks and across Puget Sound. Both the Skagit trip and the salmon barbecue have been arranged as family events. The traditional evening banquet will be held on August 18.

Full details of the technical program, as well as information on social events, accommodations and the like, will be printed in the July issue of CIVIL ENGINEERING.

Power Division Helps with Power Conference

Nearly 3,000 attended the 22nd annual meeting of the American Power Conference, held in Chicago recently with the largest registration in the history of the conference.

The American Power Conference is an annual event sponsored by the Illinois Institute of Technology, with the cooperation of fourteen universities and nine professional societies. ASCE, which has long cooperated in the conference, has taken an especially active part this year. The Power Conference is arranged with as many as five simultaneous meetings in fields of interest to engineers associated with the power industry. Primary emphasis is on steam power, but this year there was one full day of sessions on hydroelectric power. Other meetings of interest to civil engineers were a half-day session on water technology, including discussion of surface-cooling effects of ponds for cooling water supply, and a session on electrical transmission in which the design and testing of a steel transmission tower for a 345-kv power line was discussed. Another paper described determination of moisture and density in large coal piles using nuclear probes which were originally developed for soil density tests.

A half-day session on central stations and auxiliaries was sponsored by the ASCE Power Division. Presiding at this meeting was Marcel P. Aillery, chairman of the Power Division Executive Committee, with Richard N. Bergstrom as co-chairman. The papers described difficulties encountered with large concrete chimneys and various types of auxiliary equipment for power plants.

A special evening session on advanced power concepts described the future of such subjects as magnetohydrodynamics.

For Air Transport Division officers Chicago's O'Hare Airport proved a logical meeting place. Significant action of this meeting of the Executive Committee was early planning for an international conference on engineering aspects of air traffic safety as a cooperative endeavor with other groups. Seated are Chairman Reginald Sutherland and Board Contact Member Thomas Fratar. Standing, in usual order, are Ronald White, William Alexander, William Boland, and Don Reynolds.

EJC Studies Decline In Freshman Enrollment

The causes for the decline in freshman engineering enrollment in the United States were revealed in a special survey conducted by the Engineering Manpower Commission of Engineers Joint Council. The study covered in detail 151 of 231 United States colleges which offer degree credit engineering courses. Approximately one-half of these reported a lower freshman enrollment in the fall of 1959 than in 1958. An increasing number also disclosed greater attrition rates for engineering students.

Geographic areas most affected by the enrollment decline are the South, South Central, and Mountain states. Public institutions in these areas are the ones particularly affected. Private institutions—particularly in the East and Midwest—did not suffer as large a decrease.

Reasons for the decline (compiled from the statements of 151 engineering deans) appear to be:

1. Increased interest by qualified students in other fields of science, especially since the space age has glamorized science in public opinion.
2. Concern over the rigors and demands of engineering education.
3. Decrease in applications from students possessing genuine interest and motivation for engineering.

Copies of the study are available from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

Society Commends Student Chapter Work

President Marston has announced the annual awards to Student Chapters for outstanding work during 1959. Fifteen Student Chapters have been honored with Certificates of Commendation, and 63 Chapters have been awarded Letters of Honorable Mention.

Chapters receiving Certificates are:

Northeastern Region
University of Maine
Manhattan College
University of New Hampshire

Middle Atlantic Region
Carnegie Institute of Technology
University of Cincinnati
University of Maryland

North Central Region
Kansas State University
South Dakota State College
Washington University

Western Region
University of Arizona
Montana State College
University of Southern California

Southern Region
Southwestern Louisiana Institute
Texas Technological College
University of Virginia

The Letters of Honorable Mention commending Chapters for their excellent work have been awarded to the following schools:

Northeastern Region
Polytechnic Institute of Brooklyn (Day Session)
Brown University
Clarkson College of Technology
Cooper Union
The City College of New York
University of Massachusetts
Newark College of Engineering
Northeastern University
Rensselaer Polytechnic Institute
University of Rhode Island
Rutgers University
Syracuse University
University of Vermont
Yale University

Middle Atlantic Region
University of Delaware
Johns Hopkins University
The Drexel Institute of Technology
Villanova University
University of Detroit
West Virginia University
University of Michigan
Fenn College
Case Institute of Technology
Lafayette College
University of Dayton

North Central Region
University of Arkansas
Northwestern University
University of Notre Dame
Iowa State University
University of Kentucky
University of Missouri
Missouri School of Mines and Metallurgy
University of Nebraska
University of Oklahoma
University of Wisconsin

Western Region
California Institute of Technology
University of Colorado
Colorado State University
University of Denver
University of Idaho
University of Nevada
Oregon State College
University of Utah
Utah State University of Agriculture and Applied Science
Washington State University
University of Washington
San Diego State College

Southern Region
University of Alabama
Auburn University
The Citadel
University of Florida
George Washington University
Georgia Institute of Technology
University of Houston
Howard University
Louisiana State University
North Carolina State College of Agriculture & Engineering
University of Puerto Rico
Rice Institute
University of Tennessee
Tulane University
Virginia Military Institute
Texas Western College

Role of Consultant in Federal Public Works

A survey report entitled "The Role of the Consulting Engineer in Federal Public Works Projects" is now available from the National Society of Professional Engineers, 2029 K Street, N.W., Washington 6, D. C. The report —prepared by the NSPE's Functional Section for Consulting Engineers in Private Practice—is based on a survey of 1,464 engineering service contracts with 17 different government agencies and bureaus.

The report shows that average fees charged by private engineering consultants on government projects are considerably lower than widely publicized cost figures. On total construction costs of $4,325,010,612, the report lists engineering design contract fees as totaling $127,694,354, resulting in a computed average percent for design of 2.95.

Copies of the 144-page report are priced $3 each (half price to NSPE members).

ASCE Technical Activities Discussed at Joint Meeting

Joint meeting of Nebraska and Iowa Sections was a feature of recent combined meetings and conferences in Omaha. The dinner session featured a panel discussion on techical activities of the Society. ASCE Vice President Lloyd D. Knapp (center), who headed the panel, is surrounded by President Harris Seidel, of the Iowa Section, and Director N. T. Veatch, of District 16, on the left, and by Don P. Reynolds, Assistant to the Secretary of ASCE, and Lawrence E. Miller, president of the Nebraska Section, on the right.

The Younger Viewpoint

Committee on Younger Member Publications

Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	William R. Walker 4600 Franklin Ave. Western Springs, Ill.	Judd Hull 3178 Almeria San Pedro, Calif.

A Job Well Done

Since August 1958 when "The Younger Viewpoint" was initiated in Civil Engineering, *this department has been ably conducted by Milton Alpern of the Metropolitan Section. His inspiration and guidance have done a great deal to make this "Voice of the Younger Member" an ever-increasing force in the ASCE. It has often been said that the hardest part of anything is getting it started. Milt has done an excellent job of nursing "The Younger Viewpoint" along in its early days. The Society, especially the younger members, is greatly indebted to Milt Alpern for his service and efforts on behalf of the membership. As Milt moves on to other activities we wish him the best of luck and send him our thanks for the fine job he has done on "The Younger Viewpoint."—W. D. Lirizing*

Flashback—

A few of the main impressions that Milton Alpern has gained over the past two years in administering this column make very worth while reading. His comments follow:

A New Communication Medium

"To have participated during the birth and infancy of this column as a new communication medium was at once an honor, a privilege, and a frustrating experience. It was, however, also a pleasure to work with the very cooperative committee members who have been listed on the masthead for every issue.

"At this time of turning over the chairmanship to the very capable hands of Walter Linzing I feel impelled to report briefly on the pattern that seems to have become evident from the collection of younger viewpoints that have crossed my desk during the past many months:

"It seems that we Civil Engineers are not too happy with our lot and that the crux of this dissatisfaction may be the lack of appreciation and respect for what we do by both ourselves and those whom we serve. And this is, indeed, a paradox since even casual perusal of the world about us shows that the Civil Engineering profession has indeed provided the material backbone and substance of our civilization. Certainly we have nothing to be ashamed of!

"Perhaps, in the zeal exerted by our professional forbears to establish a profession that was perfectly honorable and ethical—perhaps the goal was overstepped to the extent that we now find ourselves placing the service motive too far above that of the 'personal gain' that is so necessary to guarantee the continuance of this service! Perhaps it is basically an inadequate fee structure that is causing the Younger Viewpoint to consist of complaints about salaries, about inadequate attention by members of the practicing profession to the development of engineering education, about poor college recruiting practices! Would the existing apathy by members of our profession for matters of professional concern be decreased sharply if our fees would permit all civil engineers to take time for thought, reflection and community and professional service instead of only the very few dedicated or financially fortunate ones?

Greater Response Called For

"In retrospect, probably my most significant impression has been the initial and long-standing lack of response of our people to the opportunity for expression offered by this page. It is with sincere pleasure that there is now detectable an apparent increasing interest in the page. With hope that I may have contributed something to the growth of our profession by the stumbling efforts of the past months, I extend my best wishes to the fine committee in its future work."

This Month's Editor

This month's editor is Judd Hull, Zone IV representative, who has edited and forwarded the following material from the West Coast:

Answer to Disillusioned Young Engineer

"I strongly disapprove of G. J. Stepanek's letter published on page 90, April 1960 issue of Civil Engineering. In response I present my views of ASCE written in a letter to 36 young engineers employed by the Department of Water and Power, City of Los Angeles:

> 'By your graduation in civil engineering, you have demonstrated your interest in the civil engineering profession. Since your graduation, you have been employed in the Water System, Department of Water and Power, where at first you completed a substantial orientation program in basic civil engineering procedures practiced by a water utility of the Department's magnitude.
>
> 'To enhance your standing among the civil engineers, to acquire stature and professional consciousness, I can think of no better way than affiliation with the American Society of Civil Engineers. For the young engineer especially, ASCE provides wider sources of technical information; stimulates professional activity on the national and local levels, gives special attention to the professional and economic aspects of the practice of civil engineering, and guards against forced affiliation of civil engineers with various unions. Membership in ASCE carries a degree of professional standing second to no other organization!
>
> 'I cordially invite you to join the ASCE! You may do so by filling in the enclosed application blank, then telephone me, Extension 3898, and I shall process it for you. The enclosed "Information" sheet will answer many of your questions.
>
> Fred Camp, *Chairman*
> New Members Committee
> Los Angeles Section, ASCE'

The Importance of Registration

The following excerpts on registration will be of interest.

"For any young engineer to take the attitude that registration for him is unnecessary because it is not required by his employer may, at some future date, be disastrous to his career. Many government agencies, at national, state and local levels, are starting to recognize the value of registration as a qualification for professional engineering positions, particularly those of greater responsibility. If the trend continues, it appears likely that by the time most of today's young engineers are ready for retirement, registration may be a requirement for most engineering positions of importance in government and industry.

"Possibly a more important factor which will, in future years, make professional registration of real value to today's young engineer is the gradual recognition by the American public of registration as the qualification for an individual to practice engineering and to call himself an engineer. The attitudes of government and industry are largely reflections of the attitudes of the U.S. public. The public already accepts and demands state registration as the quali-

(Continued on page 80)

Some Ideas

K+E

for your file of practical information on surveying . . . from
KEUFFEL & ESSER CO.

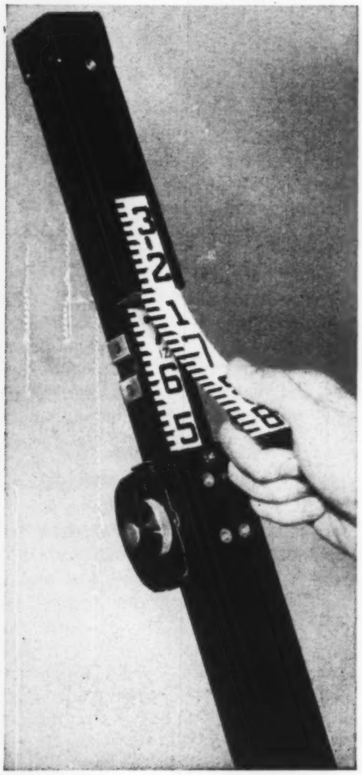
"For want of a nail . . . the battle was lost." This might well be the epitaph for many a tardy survey. The right surveying accessories can do wonders to speed a field party's operation . . . and the lack of same can cause delays in a hundred minor ways a day. How goes the tempo of your work lately? . . .

Does your flagging really flag?

This K&E flagging does everything but tie its own knot. Made of tough, embossed vinyl plastic, it's practically impervious to time and tempest. Unlike the "quick-to-quit" red cloth commonly pressed into flagging service, this plastic flagging resists wind ravel like the stake itself, remains supple even at – 35° F., tears quick and clean, has exceptionally high tensile strength, and takes both pencil and ball-point pen like paper. Available in five high-visibility colors (red, yellow, blue, orange and white), K&E Plastic Flagging (No. 6525) measures 1¼" in width and comes in handy 4" diameter, 300' rolls. Great for gift wrapping and decorating, too!

You're only as good as your scales

A complete line of hard-to-get items has long been a K&E specialty. Of particular interest here is K&E's comprehensive line of Leveling Rod Replacement Scales. Available for all K&E metal-face rods, these replacement scales are marked in the conventional pattern and design in feet, 10ths and 100ths. In addition, they feature "ready-reading" foot numbers in red between the 3rd, 4th, 6th and 7th tenths to facilitate reading on short shots when the main foot marks are likely to be outside the field of view.



If your off-the-rod readings seem to be a bit fuzzy lately, don't throw out an expensive rod, simply replace the face with an inexpensive *new scale*. It takes but a few minutes with a screwdriver and small hammer to install one of these nominally-priced replacements. And how about carrying a spare for emergencies?

Should a leveling rod be level?

The unassisted naked eye – despite its widespread popularity – is *not* the tool to guarantee a vertical leveling rod. A handy K&E device called a Rod Level (No. N6299) is the proper Rx here. It's a simple bubble unit on a long-angle contact arm that affixes to the edge of the leveling rod in semi-permanent fashion. When the bubble is centered, the rod is vertical . . . and no mistake about it! This inexpensive but accurate device eliminates guesswork, makes for truly *precise* readings, and works easily – no juggling act required, just a fairly steady hand.

Now, for carrying this equipment...

. . . may we suggest the handsome Surveyor's Leather Bag (No. 6540)? Here's a sturdy carry-all expressly made to withstand the rigors of field work. Heavy-duty stitched throughout, it has an adjustable shoulder strap with movable pressure-pad, rust-resistant brass hardware, separate pad and paper slot, roomy interior pocket, and a rich riding-boot finish in natural tan. Measuring 10" high by 12" across by 2½" wide, it affords plenty of room for field book, plumb bob, tacks, targets, pencils, keel, measuring tape, numerous rolls of plastic flagging, replacement scales, and a rod level . . . to say nothing of your lunch, a few trout flies, etc.

All these and other K&E time-savers are available from your local K&E Dealer . . . or you can send us the coupon below for further information.

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☐ Surveyor's Leather Bag

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fication for an individual to practice other professions, and there is no reason to think that it will not demand registration as the prerequisite for the practice of engineering, whether as an individual employed by industry, government or as a consultant.

"It is this writer's belief and fervent hope that trends toward increased recognition of the importance of engineering registration will continue. Certainly no young engineer can afford to take the chance that registration will never . . . be required for his continued professional advancement."

Milton L. Sharp, A.M.
Reno, Nev.

Review Courses For Licensing Examinations

Another interesting letter deals with licensing examinations:

"I was interested in the comments (Civil Engineering, December 1959) regarding pros and cons of the review course for the licensing examinations given in New York State. I suspect that most all the states provide a similar course or else the need is met by individuals forming study groups prior to the exams. I myself feel that the review course or study group is necessary as well as beneficial to the engineering profession.

"In most cases the applicants' experience has been narrowed down to just one or two facets of civil engineering due to job or employer requirements. Both the exam and the review force the applicant to become re-aware of the civil engineering field in its complete form. In our complex engineering society of today this awareness is a basic requirement for the truly professional engineer.

"As far as the exam review or study group being a quick relearning of problem-solving techniques, let's face the facts. A certain amount of an engineer's ability to perform professional services is dependent on a knowledge of problem-solving techniques, while the rest of his services are dependent on the ability (which problem-solving techniques help to develop) to approach a general problem in a logical, concise manner. Most exams that I have seen provide questions in problem form that test these two fields of ability reasonably well. Questions concerning the latter ability are hard to find because they involve a degree of judgment in most cases and do not lend themselves to problem-type solutions. The answer to this, I believe, can be found in the essay-type question.

"As an example of essay-type questions, consider those given in the law exam in most states. Part of the exam is based on a factual knowledge of law (which corresponds to problem-solving techniques) and the rest is based on how good an argument in essay form the applicant can give to a particular case involving the law even though no specific answer is possible. This type of question certainly is a test of professional thinking when graded by experienced lawyers and analogous questions should be included in professional exams for engineers."

R. H. Tutty
Instructor, Civil Eng.
University of Idaho

New Members

It is a fact that the largest single concentration of potential members of Local Sections are within the Associate Member age group. How do we solicit participation of these non-subscribing Associate Members? Creation of an Associate Member Forum in each Section? Solicit this group by a letter outlining the advantages of local participation? Appointment of Associate Members to all local committees? Closer coordination of Local Sections and Student Chapters? Personal solicitation by the Membership Committee of engineering offices, both public and private, where there is a large concentration of eligible potential members? What are your suggestions?

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closed May 1, 1960. See 1960 Official Register, page 149. Topic for 1961 contest to be announced later.*
FREEMAN FELLOWSHIP:	*1961 contest to be announced. See Official Register, page 154.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1961-62 contest closes April 1, 1961. See Official Register, page 156.*
RESEARCH FELLOWSHIP:	*1961 contest closes Jan. 1, 1961. See Official Register, page 156.*
ERNEST E. HOWARD AWARD:	*Closing date Feb. 1, 1961. See Official Register, page 148.*

Nuclear Congress to Become Biennial Affair

The next national Nuclear Congress will be held in New York in 1962, according to an announcement from Engineers Joint Council, sponsoring organization of the Congress. This decision by the Board of Directors has been made public by EJC President Augustus B. Kinzel.

According to Dr. Kinzel, the change in policy from holding Congresses annually (which has been in effect since the start of the Congresses in December 1955) to meetings in alternate years "reflects the current needs and interests of the engineering and scientific professions and the nuclear industry."

Dr. Lauchlin M. Currie, a pioneer in the nuclear energy industry and chairman of the EJC Nuclear Congress Committee, said that, "Because of the present pace of development of nuclear technology, our Nuclear Congress Committee felt that it was in the best interests of the industry and the other participating organizations to have major international meetings and exhibits only once in two years." It is believed that more fresh material will be available after a two-year interim.

New ASCE Manual of Practice Available

A major addition to the ASCE Manual of Practice series is a new publication entitled "Design and Construction of Storm and Sanitary Sewers." The new reference is also identified as Manual No. 37.

As in the case of Manual No. 36, "Sewage Treatment Plant Design," the new publication is the result of several years of collaboration between the Sanitary Engineering Division of ASCE and the Water Pollution Control Federation (formerly the Federation of Sewage and Industrial Wastes Associations).

The 12-chapter manual consists of 283 pages, plus numerous tables, figures and references. As the first extensive collection of information on the subject, it makes a valuable addition to the field of waste-water technology.

The manual may be obtained from ASCE Headquarters, 33 West 39th St., New York 18, N. Y., at $3.50 a copy to members and $7.00 to nonmembers. The same rates are charged if orders are placed with the Water Pollution Control Federation.

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Only Gar-Bro offers you patented double clamshell gates, patented accordion hopper attachments, suspended steel sub-hopper attachments with Elephant Trunk or Steel Drop Chutes. Yes, and only Gar-Bro Buckets are equipped with fittings for easy attachment of these important accessories. No wonder contractors everywhere prefer Gar-Bro Concrete Buckets.

See your local Gar-Bro dealer or write for catalog which illustrates and describes more than 300 items for handling and placing concrete.

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**Concrete for dams, bridges, buildings and all construction projects.*

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Permanently smooth bore provides excellent flow characteristics.

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"K&M" Asbestos-Cement Sewer Pipe helps you provide the best sewer service available . . . with tax savings that go on year after year.

This thrifty pipe is infiltration-proof, even when external water pressure is 25 psi. Prevents your sewer system from reaching full capacity years ahead of schedule, due to water infiltration. "K&M" Asbestos-Cement Sewer Pipe, with exclusive, patented FLUID-TITE Coupling, forms a permanently tight seal.

In planning your system, you can build on flatter grades with "K&M" Asbestos-Cement Sewer Pipe. Need fewer lift stations. The permanently smooth bore of "K&M" Asbestos-Cement Sewer Pipe has a Manning factor of n = 0.010. Flow characteristics are excellent. Inspections and treatment loads become less frequent.

This thriftiness carries over into installation. Neither weather nor soil conditions need hold up work. The "K&M" FLUID-TITE Coupling slides on in just two easy steps. Longer pipe lengths minimize the number of joints.

Write today for more detailed and illustrated information on hardy "K&M" Asbestos-Cement Sewer Pipe. Learn why thousands of progressive communities have turned to this durable quality pipe. Write to: Keasbey & Mattison Company, Ambler, Pa., Dept. P-1560.

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K·M BEST IN ASBESTOS

Easy installation! Couplings join quickly. No heavyweight coupling pullers needed.

"K&M" PLASTIC SEWER PIPE complements "K&M" Asbestos-Cement Sewer Pipe in many sewer systems. Excellent flow characteristics and permanently tight joints. Write for Technical Bulletins on "K&M" High-Impact Styrene-Alloy Sewer Pipe. Dept. P-1560.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Highlight of the May 4 annual dinner-meeting of the **Central Pennsylvania Section** was installation of the Section's new officers. John R. Dietz was installed as president; T. Robert Kealey, as first vice-president; Jacob Frank, as second vice-president; William L. Raymond, Jr., as secretary-treasurer; and Calvin G. Reen, as director (to May 1962). The board of directors also includes Fred L. Morgenthaler, Jr., John J. Molloy and Dalzell M. Griffith.

The Associate Member Forum of the **Los Angeles Section** has elected Paul Tichenor as its new president to succeed Tom Drum, who had to resign because of moving out of the area. Jim Kirkgard becomes first vice-president, replacing Mr. Tichenor, while Secretary Judd R. Hull and Treasurer Manuel Morden continue in their present posts.

Associate Members of the **Maine Section** sponsored a recent meeting featuring the new sewerage system at Winthrop. Although the system will serve a population of only 3,800 at a relatively high average annual assessment of $60 per family, it is significant of the foresight of a small Maine community in protecting its waters for recreation—increasingly important to the state's economy. Robert T. Jones, project engineer for Whitman & Howard, Inc., consulting engineers for the system, explained planning, construction, and design of the system, and conducted a tour of the treatment plant. The Section's tenth anniversary meeting will be held on July 30 at the Naval Radio Installation at Cutler. President Marston is expected to attend.

Outstanding civil engineering seniors in the engineering schools in the Metropolitan area received Robert Ridgway awards at the **Metropolitan Section's** May 18 meeting. The awards, honoring the late Robert Ridgway, Past President of ASCE, were bestowed on Myron Sherman, College of the City of New York; Robert A. Nelson, Columbia University; James Radziminski, Cooper Union; John F. Keane, Manhattan College; Robert Sorensen, Newark College of Engineering; William F. Ogilvie, New York University; Frank J. McClean, Polytechnic Institute of Brooklyn; and William J. Wolff, Rutgers University, on the basis of participation in Student Chapter activities, scholarship, extracurricular activities, and general character and personality. Each of the winners receives his entrance fee to ASCE, one year's national dues, one year's Local Section dues, and an Associate Member badge.

Following dedication of the new civil engineering building at the Missouri School of Mines and Metallurgy on April 8 (page 74), a joint meeting of the **Mid-Missouri Section** and the college's Student Chapter was held on the school campus at Rolla. Among the honored guests were Executive Secretary William H. Wisely, Past President Enoch R. Needles and current President, Frank A. Marston. President Marston, who spoke on "Civil Engineering—A Profession," also gave an illustrated account of construction progress on the new United Engineering Center Building.

James E. Foster, a hydraulic research engineer at the U. S. Waterways Experiment Station in Jackson, Miss., read a paper on "The Design, Construction and Operation of Fixed-Bed River Models," at a recent meeting of the **Jackson Branch** of the **Mid-South Section.** The paper was one given by Mr. Foster at the ASCE Annual Convention in Washington last fall. A lively question and answer period followed the reading.

William Murphy (right), professor of soils engineering at Marquette University and past president of the Wisconsin Section, was introductory speaker at a recent Wisconsin Section meeting devoted to soil and foundation engineering. Other speakers (left to right) were Willard Warzyn, consulting engineer and another past president of the Section, and Clifford Lawson, soils engineer, Wisconsin State Highway Commission.

A memorable program, both in its technical and social aspects, was held jointly by the **Philadelphia Section** and the Philadelphia Post of the Society of American Military Engineers on April 27. A welcome was extended by Section Vice-President John J. Gallen, followed by an informative talk by Col. T. H. Setliffe, Philadelphia district engineer, Corps of Engineers, on the engineering development plan for the Delaware River Basin. Colonel Setliffe impressed his audience with the assurance that a good start has been made on the $425 million river development scheme which encroaches on the terrain of four major states—New York, Pennsylvania, New Jersey and Delaware. But, Colonel Setliffe stressed, the road ahead is a long and hard one and the local and municipal communities who will be the beneficiaries of the improvement program, must be aroused to their own responsibility in the matter.

The **Tennessee Valley Section's Knoxville Branch** had one of its largest meetings in many years—over 70 members, students and guests—on April 13. James J. Goulden, chief director of the Khuzestan Development Service, Development and Resources Corporation, and his wife gave a first-hand account of their recent experiences in Iran. The country, said to hold the greatest promise of development

(Continued on page 86)

Mexico Section officers (new and old) are photographed here. They are (left to right) Pedro Albin, vice-president; Gustavo L. Ramirez, outgoing vice-president; Miguel Montes de Oca, outgoing president; Jose Vazquez del Mercado, new president; and Humberto J. Benet reelected secretary-treasurer.

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Hawaiian Dredging & Construction Co., Ltd., General Contractor
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Concrete Engineering Company, Ltd., Prestressed Concrete I-Joists
Vladimir Ossipoff, Architect
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TYPICAL FRAMING, DIAMOND HEAD APARTMENTS
Total Lineal Ft of I-Joists 15,000
6'-6" for 28'-0" Span
4'-6" for 40'-0" Span
11 ⅜" ⌀ Strands
9"
Prestressed Concrete Piles go way down to raise Hawaii's most beautiful apartments

The new, 12-story Diamond Head Apartments, built at a cost of more than $1,700,000, is a model of beauty, luxury and impressive construction methods.

The structure's seashore site – literally in the shadow of Diamond Head on the Island of Oahu—made for some difficulties during the foundation phase. The refusal depth of the prestressed concrete underpinnings in the unpredictable coral was unknown and could only be discovered by driving. One pile, in fact, broke through a coral shelf and sank out of sight. An excavation was dug until the top of the pile was recovered. Then dowel bars were placed in the top and an additional pile spliced on and driven to refusal – some 70 ft down.

The floor framing throughout is of precast, prestressed concrete I-joists, with poured-in-place slab, as shown in the drawing above. This type of economical framing is rapidly gaining in popularity. One main reason for its economy is that the spacing between joists can be arranged to take standard plywood form sheets, making for extreme simplicity of installation.

This luxury structure is an outstanding example of prestressed concrete's ever growing acceptance and its ready adaptability to *improvements in the method itself*. Pile splicing is a comparatively new technique that brings still further benefits to this remarkable, economical construction method. Ever-present are prestressed's inherent advantages; great strength, construction speed (members can be fabricated and trucked to the job site with great dispatch), insurance and maintenance benefits and wide design adaptability.

Roebling has long advocated the prestressed method and has manufactured highest quality stress-relieved prestressing strand for fabricators throughout the country. Our knowledge, data and experience, covering every phase of prestressed concrete, are at your disposal. We invite inquiries on whatever aspect may interest you. Write Roebling's Construction Materials Division, Trenton 2, N. J.

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in the Near East, is only 20 percent arable, has a population 30 percent nomadic, a city population where only 35 percent are literate, and a village population where less than 1 percent are literate. Things are looking up however in Khuzestan with Dez Dam scheduled for completion in late 1962. The dam will have a storage comparable to Norris Dam (Tenn.), a large generating potential, capacity to irrigate 360 acres, and is worth an average of a million dollars a year for flood control.

Over 70 members and guests of the **Dallas Branch** of the **Texas Section** recently heard Tom Calhoun, a petroleum engineer with DeGoyler & MacNaughton, talk on the possibility of Federal legislation controlling the activities of the Federal Government in regards to the hiring of consulting engineers. Mr. Calhoun's remarks aroused considerable discussion . . . Guest speaker at the April 12 meeting of the **El Paso Branch** was Harold Tillman, engineer for the City-County Health Unit of El Paso. The program, among the most interesting the Branch has ever had, dealt with the work of the Health Unit in the areas of air pollution, sanitation, inspection, fallout and smog.

The functions of ASCE on both the national and local levels were ably presented by Charles Yoder and Don Roethig, at a recent meeting of the **Wisconsin Section.** Mr. Yoder outlined the organizational make-up of ASCE, while Mr. Roethig spoke on local operation and methods of financing and costs, referring to the fact that the Wisconsin Section is often used as a model on such matters.

(Continued on page 106)

At a recent meeting of the Nashville Section consulting engineer L. R. Currey, Jr., (center), was presented with a Life Membership Certificate. Doing the honors are Section President John T. Dennison (left) and Wilbur Sensing, Sr.

At a spring meeting of the Jacksonville Branch of the Florida Section George B. Hills (right) presented Life Membership Certificates to George W. Simons, Jr. (center) and Arthur F. Perry, Jr. (left). Mr. Simons, pioneer city planner, spoke on the initial planning of the City of Jacksonville.

Tacoma Section set aside April 12 to honor its living past presidents. Current president, Harold A. Hagestad (left, standing), presented certificates to (left to right, seated): R. W. Finke, 1945; A. M. Buell, 1953; J. P. Hart, 1936; E. C. Dohm, 1937; C. H. Williams, 1943; and R. C. Knapp, 1939. Standing, in same order, are: Harold A. Hagestad; W. A. Kunigk, 1934; D. G. O'Shea, 1956; E. C. Simpson, 1958; W. T. Robertson, 1959; J. S. Abel, 1950; R. L. Greene, 1952; H. F. Sitts, 1957; N. E. Olson, 1951; C. E. Andrews, 1947; H. J. Whitacre, 1954; and F. M. Veatch, 1946. Not present for the ceremonies were E. G. Warner, 1938; B. P. Thomas, 1940; F. C. Dunham, 1941; J. L. Stackhouse, 1948; A. Johnson, 1949; and C. C. McDonald, 1955.

Michael Gross (right), president of the Pittsburgh Section, presents a new Student Chapter charter to David Frazer, president of the Student Chapter of Youngstown University at the Chapter's first annual dinner-dance held on April 23. Senior members of the newly organized Youngstown Chapter were among the onlookers.

PUTS SCHOOLS UNDER ROOF FAST

72,237 square feet of Macomber V-LOK cut construction time on Iowa's Fort Madison High School.

ARCHITECT-ENGINEER: Karl Keffer Associates

CONTRACTOR: Fane F. Vawter & Co.

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saves weeks of construction time

V-LOK rigid, interlocking steel framing erects in days with roof on — ready for interior finishing, regardless of weather. This high-strength structure combines quality with overall construction economy; and no-waste-motion assembly speeds occupancy.

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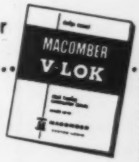
Utilize V-LOK'S speed, economy and earlier occupancy for your next school.



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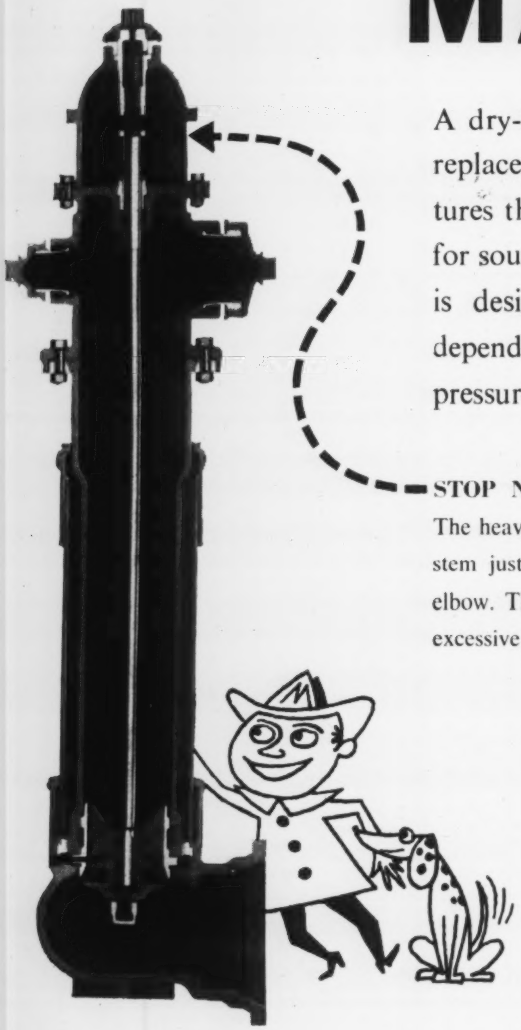
A dry-head hydrant; adjustable nozzle levels; replaceable barrel—three of many major features that help make Mathews the one hydrant for sound community protection. The Mathews is designed to be always operable, always dependable, always ready to deliver at full pressure.



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AND ALL THESE OTHER FEATURES, TOO:
All working parts contained in replaceable barrel • Head can be faced in any direction • Replaceable head • Any nozzles you specify • Nozzle levels raised or lowered without excavating • Leakproof because stuffing box is cast integral with nozzle section • Operating thread only part requiring lubrication • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • With bell, mechanical joint or flange pipe connections

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Manufacturers also of Mathews Flange Barrel Hydrants, R. D. Wood Hydrants, R. D. Wood Gate Valves, and "Sand-Spun" Pipe (centrifugally cast in sand molds)

New steels are born at Armco

Armco Asbestos-Bonded Pipe being installed at a new plant of the Bestwall Gypsum Company. Lightweight equipment handles 20-foot lengths of pipe. Note water in trench.

Consulting Engineers Chose Armco Pipe for Difficult Industrial Sewer Job

A 3,200-foot combined sanitary and storm sewer was part of a construction project at the new gypsum plant of the Bestwall Gypsum Company, Brunswick, Georgia. Complicating the usual problems were the soil of a tideland area, a high water table, and salt water from the adjacent Atlantic Ocean. Choice of the consulting engineers for this sewer was Armco Asbestos-Bonded® Pipe.

These consulting engineers, Johnson & Johnson, Inc., of Chicago, said, "The reasons for selection of Armco Asbestos-Bonded Pipe for this installation were: It has excellent corrosion resistant qualities in tideland and salt water conditions as exist in this location; the pipe is of relatively light weight and long lengths, making it suitable for installation in a soil where settlement is a consideration such as in this location; use of positive connections were possible here, thus reducing the problem of the lines pulling apart if settlement occurs; and the pipe was economical to use."

The new Bestwall Gypsum Company plant will make products from gypsum brought in by ocean-going ships.

Armco Asbestos-Bonded Pipe, with invert paving plus a double full-coating of asphalt, was supplied in diameters from 8 to 30 inches. Mechanical contractors on the project were James E. Smith & Sons, Inc., of Louisville and Atlanta.

Write us for factual data on Armco Corrugated Metal Structures for sewers and other drainage applications. Armco Drainage & Metal Products, Inc., 4010 Curtis Street, Middletown, Ohio.

ARMCO DRAINAGE & METAL PRODUCTS

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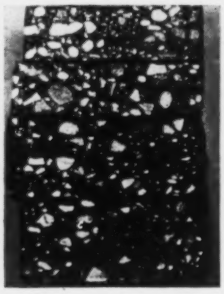
***CONTRACTOR:* MINNESOTA VALLEY IMPROVEMENT CO., GRANITE FALLS, MINN.**

The load-carrying capacity of Minnesota Trunk Highway No. 7 was doubled by resurfacing it with 7½ inches of hot-mix with Texaco Asphalt.



Cross-section assembled in the laboratory from specimens cut from the road of 7½-inches of hot-mix with Texaco Asphalt. The four layers from the top down are the 1½-inch surface, 1½-inch binder course and 4½-inch base (laid in two courses).

ASPHALT doubles a highway's strength

The original pavement on this Minnesota trunk highway was laid in 1952. It was designed to carry 1,000 vehicles a day and a maximum axle load in spring of five tons. The pavement consisted of a 9-inch gravel base and subbase, topped by a 1½-inch surface of asphalt hot-mix.

Last year, this highway's load-carrying capacity was increased to 2,000 vehicles a day and its maximum allowable axle load in spring increased to nine tons. This was accomplished at moderate cost in a minimum of time by resurfacing the 1952 pavement with 7½ inches of hot-mix, using Texaco Asphalt. The new pavement was composed of a 4½-inch asphalt base course, a 1½-inch binder course and a 1½-inch wearing surface.

This Minnesota project is an excellent example of how perfectly Asphalt lends itself to stage construction of a highway, adding strength when called for by increased traffic, while distributing cost over the years.

Whatever your own paving problem, there is a heavy-duty, intermediate or low-cost type of Texaco Asphalt construction exactly suited to your requirements. Our 55 years of Asphalt experience is at your service. If you would like to discuss your paving needs with a Texaco Asphalt field representative, write to our nearest office listed below.

Shoulders of the new highway have a 2-inch surface of hot-mix with Texaco Asphalt, seal-coated and covered with gravel.

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Please send me your two brochures containing helpful information on heavy-duty, intermediate and low-cost types of asphalt construction for highways, streets, airports, etc.

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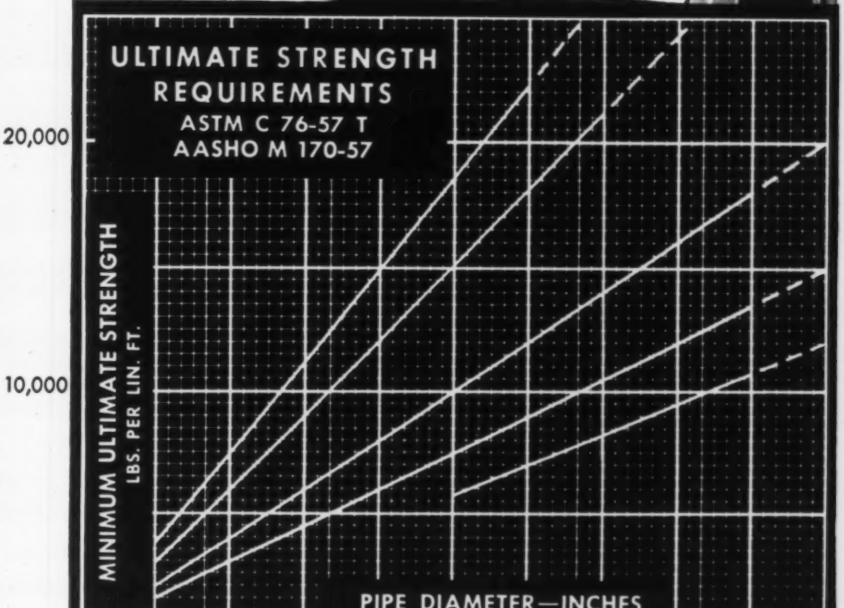

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- Lower stresses on subgrade
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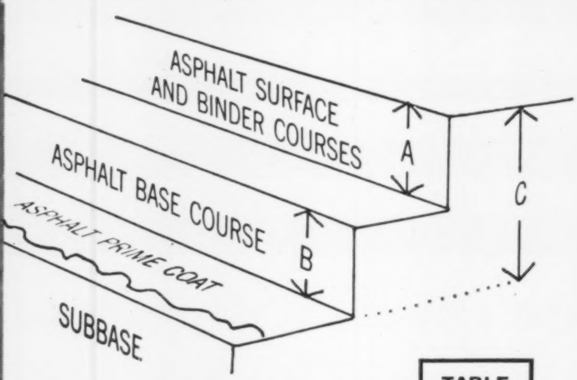
- Is not susceptible to frost damage
- Protects subbase from rain during construction
- Permits haul traffic on base without damage
- Eliminates subsurface moisture build-up
- Aids uniformity of pavement
- Does away with shoulder erosion
- Minimizes slope erosion
- Furnishes better drainage
- Prevents wheel-track rutting
- Provides for stage construction
- Improves surface riding qualities
- Increases driving and parking safety

**For use in areas where high-quality aggregates are in short supply.*

SUMMARY OF **ADVANCED**



PAVEMENT DETAIL

TABLE 1

Recommended Minimum Thicknesses of Surface-Plus-Binder and of Base Courses (inches)*

TRAFFIC	A**	B w/ Asph base	B w/o Asph base	C w/ Asph base	C w/o Asph base
Very Hvy	4	4	6	8	10
Heavy	3	3½	5	6½	8
Medium	3	2	3	5	6
Light	2	2	3	4	5

**For thickness of subbase and improved subgrade courses, see Asphalt Institute Manual Series No. 1.*

***May be reduced by substitution of Asphalt base of comparable strength on inch-for-inch basis.*

"**THE INCREASING STRESSES** now being imposed on pavements by modern heavy traffic with average tire contact pressures as high as 100 psi or more, and the anticipated future increase in wheel coverages indicate that general improvements in design and construction must be made. To meet this need, The Asphalt Institute calls to the attention of highway designers the Advanced Design Criteria given in broad detail above and designated, 'Deep-Strength' Asphalt pavements. The Institute strongly recommends the adoption of these Advanced Design Criteria in the construction of all future heavy-duty Asphalt pavements. For detailed data, you are urged to contact The Asphalt Institute District Engineer in your area."

Arvin S. Wellborn

CHIEF ENGINEER

DESIGN CRITERIA for "DEEP-STRENGTH" ASPHALT PAVEMENTS

TABLE 2

RECOMMENDED MINIMUM COMPACTION CRITERIA* (summary)

Non-Asphalt Courses

COURSE	MINIMUM (% modified AASHO Density)
Subgrades (layers not to exceed 6 inches)	
Cohesive	95%; top 12 inches 90%; balance of fill (When optimum moisture is near plastic limit, compact at moisture content approximately 1% below theoretical optimum).
Cohesionless	100%; top 12 inches 95%; balance of fill
BASES, SUBBASES AND IMPROVED SUBGRADES (Layers not to exceed 6 inches)	
All	Compaction load and contact pressures as high as material will support without undue rutting or displacement.
(proof roll with heavy rubber-tire rollers).	

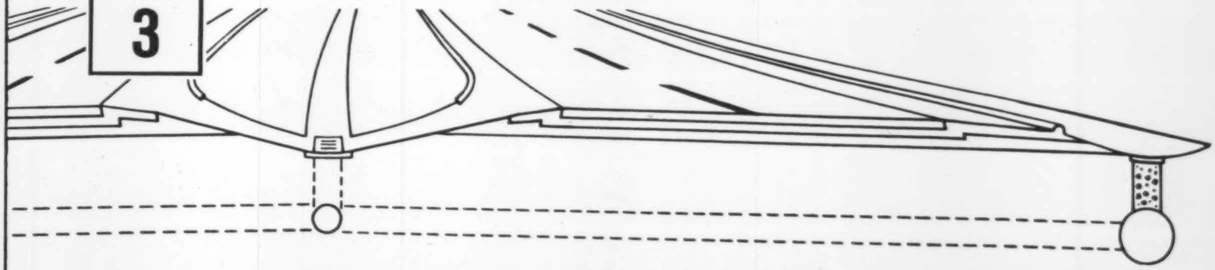
ASPHALT COURSES (base, binder, surface)

COURSE	MINIMUM CRITERIA
SUPPORTING COURSES	Flat steel-wheel rollers to be supplemented with pneumatic tire rollers having average tire contact pressures of 85-110 psi
SURFACE COURSES	Same as for Supporting Courses.

**For detailed information see The Asphalt Handbook, Manual Series No. 4.*

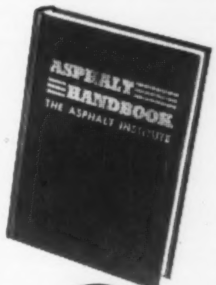
TABLE 3

FULL-WIDTH DRAINAGE (Typical Cut Section)



The new Advanced Design Criteria recommend better surface and subsurface drainage. For better *surface* drainage full-width paving is recommended. On elevated grades the water should be directed to Asphalt spillways by means of Asphalt dykes or curbs constructed on the extreme outside edge of the shoulder. For better *subsurface* drainage a depressed median is recommended wherever possible. If conditions make it mandatory to construct an elevated median, transverse drains should be connected with a longitudinal drain in the median deep enough to collect all ground water before it can find its way into the pavement structure.

NEW HANDBOOK! Now on the presses is a new edition of *The Asphalt Handbook.* It incorporates all the Advanced Design Criteria for highways implied by the term **Deep-Strength** Asphalt Construction. It also includes the latest design and research data concerning other major uses of Asphalt . . . for ditch linings, embankment facings, etc. Copies will soon be available at The Asphalt Institute office serving your area.



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Dealer: Wunder Klein Donohue Co.
both of Minneapolis, Minn.

U. S. Department of Interior, Bureau of Mines Building, Minneapolis, Minn.

Architect: Bettenburg, Townsen, Stolte & Comb, St. Paul, Minn.

Contractor: Maurice Mandel, Inc., Minneapolis, Minn.

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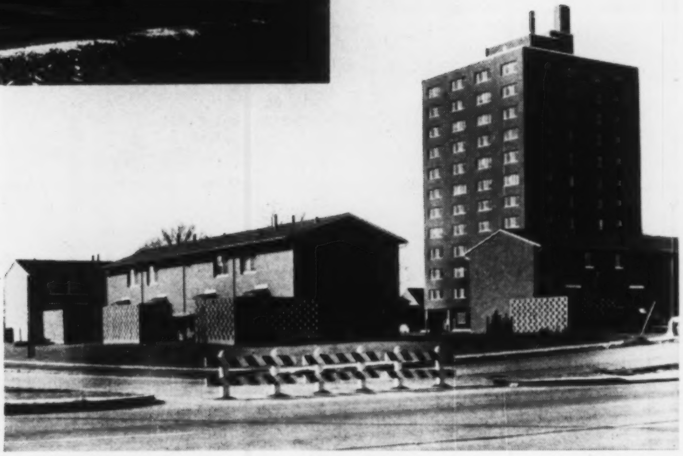

Lyndale Homes Housing Project, Minneapolis, Minn.

Owner: City of Minneapolis

Architect: Thorshov & Cerney, Inc., Minneapolis, Minn.

Contractor: Johnson, Drake & Piper, Inc., Minneapolis, Minn.

• Eight years ago mason contractor Axel Ohman reported that . . . "The economy and workability of Lehigh Mortar Cement convinces us that it meets our requirements to the utmost. It has good bonding qualities along with absence of shrinkage. We are not alone in this opinion as owners, architects and inspectors have also made favorable comments."

That Mr. Ohman still prefers Lehigh Mortar Cement is proved by its use in the three recently completed quality masonry projects pictured here.

Whether a job is big or small, modern or traditional, Lehigh Mortar Cement can help you build strong, weathertight masonry walls. Lehigh Portland Cement Company, Allentown, Pa.

SOUTHDALE MEDICAL BUILDING

Southdale Medical Building, Edina, Minn.
Owner: Southdale Management, Inc.
Architect: Victor Gruen & Associates, Los Angeles, Calif.
Contractor: C. F. Haglin Construction Co., Minneapolis, Minn.

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Two Gurley transits feature built-in optical plummets

Gurley OP-57

Gurley OP-137

The Gurley Optical Plummet Transit (Model OP-57) has proved itself to be such an important time and money saver in the field that this optical plummet feature has also been added to the Model 132 Standard Precise Transit. The new transit will be known as the OP-137.

Both these Optical Plummet Transits will save you time and trouble in setting over a point. The OP-57 and OP-137 eliminate the swing and sway of the cord and plummet—exasperating and time consuming. You will especially appreciate the increased accuracy on windy locations.

By rotating the instrument 180°, you can be assured of positive centering.

The Gurley Optical Plummet Transits are furnished with tripods which have built-in shifting heads. They allow a two-inch shift of instrument over the point, providing greater latitude in initial set-up.

Model OP-57 is recommended for very exacting work; the OP-137 for general engineering and construction work because of its shorter telescope, smaller size and its lighter weight.

Now in *two* models Gurley offers you an important advantage of the optical-reading theodolite *plus* the simplicity, ruggedness and proved performance of the American transit. *Write for new Bulletin OP-100.*

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“First cost and economical operation make Johns-Manville's Transite Pipe a practical long-term investment,” say Messrs. Johnson and Anderson, consulting engineers, pictured at right. “Despite this economy its performance is superior in many ways. There's no corrosion, negligible maintenance and continued high carrying capacity . . . helping through the years to save in the operation of the system. These many economies make it easier for communities to build and expand their water systems.”

Transite's maintained carrying capacity keeps pumping costs low. Its strength, durability and corrosion-resistance cut maintenance—provide years of trouble-free service. Further savings are effected by the sure coupling method that assures a tight seal at every joint. Add to this Transite's natural interior smoothness and you see why it helps reduce community water system costs. Let us send you “Facts and Data for Engineers” book. Write Johns-Manville, Box 14 (CE-2), New York 16, N. Y.

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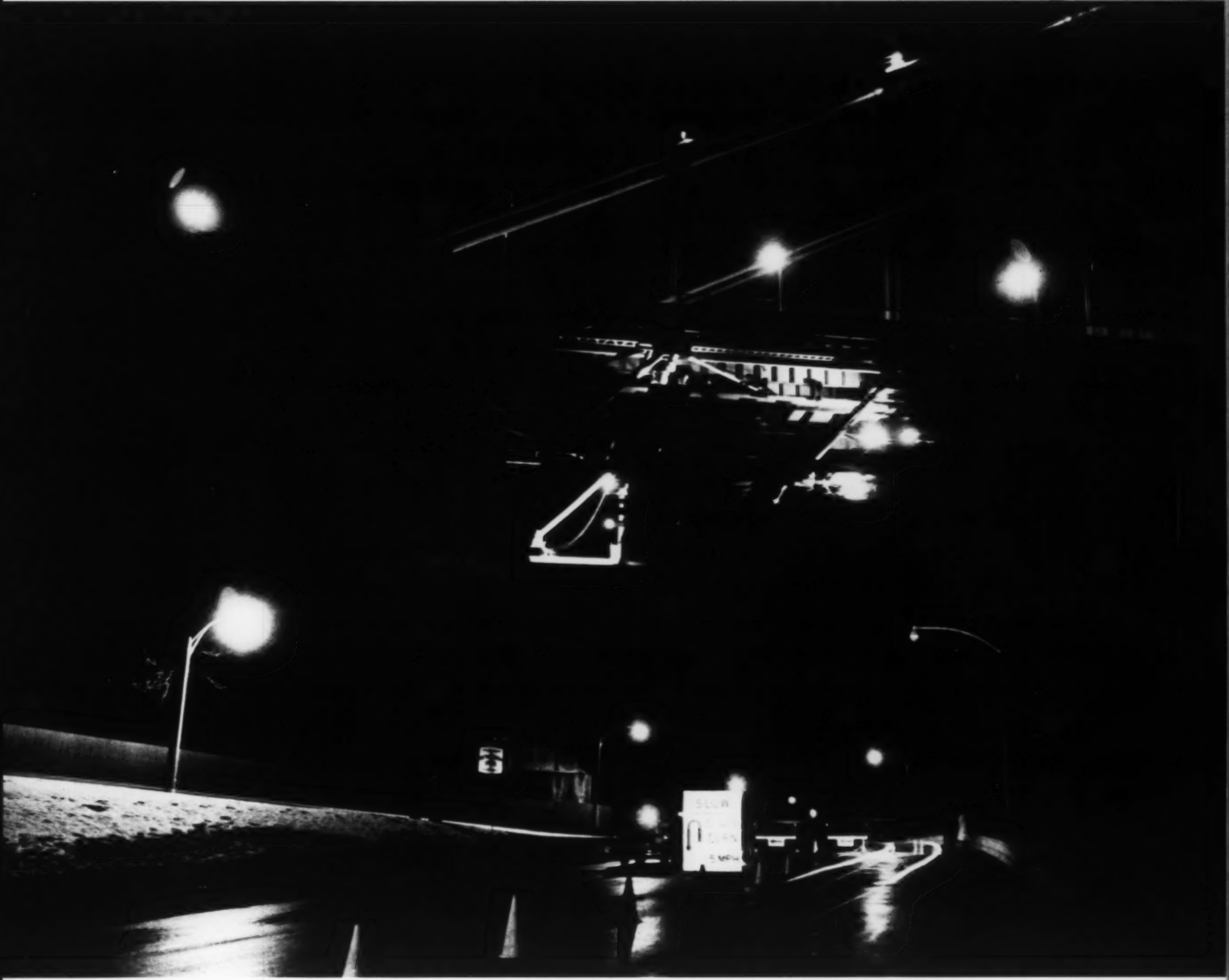
Progress Report on

STEEL CONSTRUCTION

JUNE, 1960

BETHLEHEM STEEL COMPANY



Night Shift in Manhattan

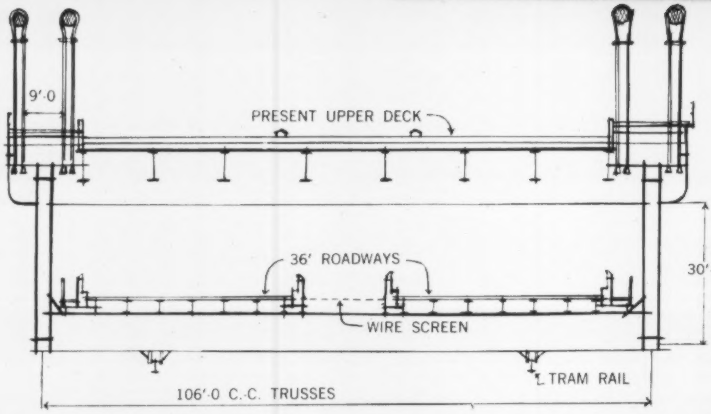
NEW YORK CITY—The time: 1 a.m., January 19. The place: George Washington Bridge, just over the southbound roadway of the Henry Hudson Parkway. The event: connecting the first of seventy-six 220-ton sections for a six-lane lower traffic deck.

In order to avoid interfering with traffic on the bridge, all work is being done from beneath the existing span. This procedure raised problems unprecedented in the history of bridge-building. For a brief description, please turn the page.

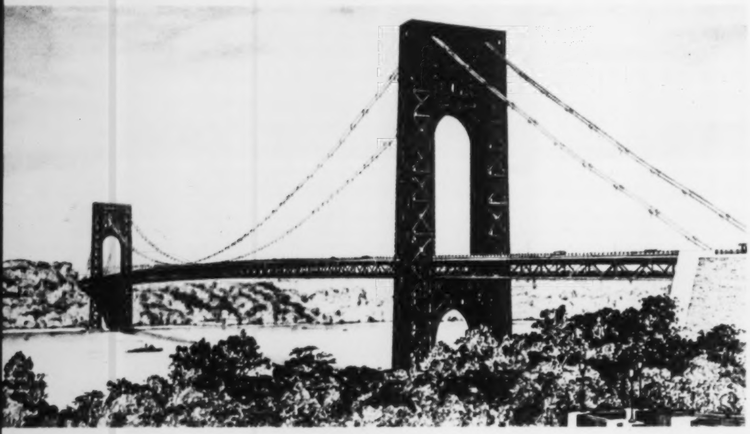
Steel

for Strength
. . . Economy
. . . Versatility

This typical cross-section illustrates the general design of the lower deck and its connection with the existing structure. The only provisions originally made for attaching the deck were gusset plates on the wind chords at floor-beam panel points sixty ft apart. The wind chords double as the top chords of the new stiffening trusses. Bethlehem bridgemen had to locate the new connections and drill the necessary holes for rivets (rivets were preferred to high-strength bolts because bolting would have required the removal of many coats of paint from the gusset plates). However, all field connections between new members are bolted.



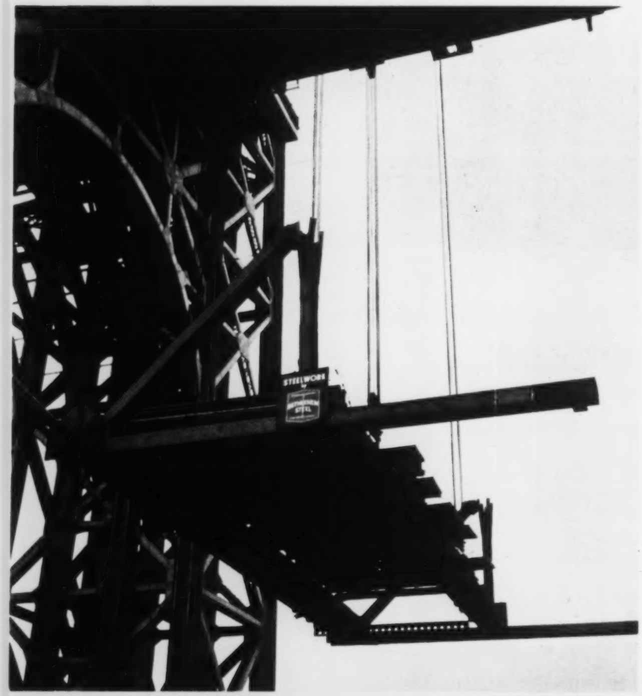
Boosting George Washington's Capacity by 75 per cent



This drawing shows the George Washington Bridge with the lower deck complete. The bridge will then have a stiffening truss of the general type ordinarily required for aerodynamic stability in long suspension bridges. Such a truss system was not originally required for this bridge, however, because of its great mass and the stiffness of its four massive, 36-in.-diameter parallel-wire cables, the largest ever spun.

Just thirty-two years ago, on June 25, 1928, Bethlehem Steel crews began erecting the magnificent towers for the George Washington Bridge, spanning the Hudson River between 178th and 179th streets. Three years and four months later the bridge was opened to traffic. Its main span, 3,500 ft between towers, and total suspended span, 4,760 ft between anchorages, made it the world's longest (it became second longest in 1937, when Bethlehem completed erection of Golden Gate Bridge with its 4,200-ft main span), and it now has the third longest center span in the world.

But even when it was opened in 1931, the George Washington Bridge was not really "complete." Its design provided for a second, lower deck. Construction of this deck to relieve the growing vehicular burden on the world-famous bridge was recommended by The Port of New York Authority in their Joint Study of Arterial Facilities in the New York-New Jersey Metropolitan Area, published in 1955. In 1957, following legislative approval in both states, the Port Authority commissioners authorized the addition of a six-lane traffic deck and construction of the necessary approaches in New York and New Jersey at a cost of some $180,000,000. The contract to fabricate and erect some 13,875 tons of steel was awarded to Bethlehem Steel Company.



Raising the first complete lower-deck section. This event took place at the New York-side sidespan. The assembly, weighing 220 tons and comprising two 30-ft panels, including two side trusses, two built-up girders, and one complete panel of the floor system, was hoisted in the daytime alongside the main tower. During early morning hours it was moved by means of the trolley system to its permanent position over the heavily traveled parkway. The latter operation is pictured on our first page.

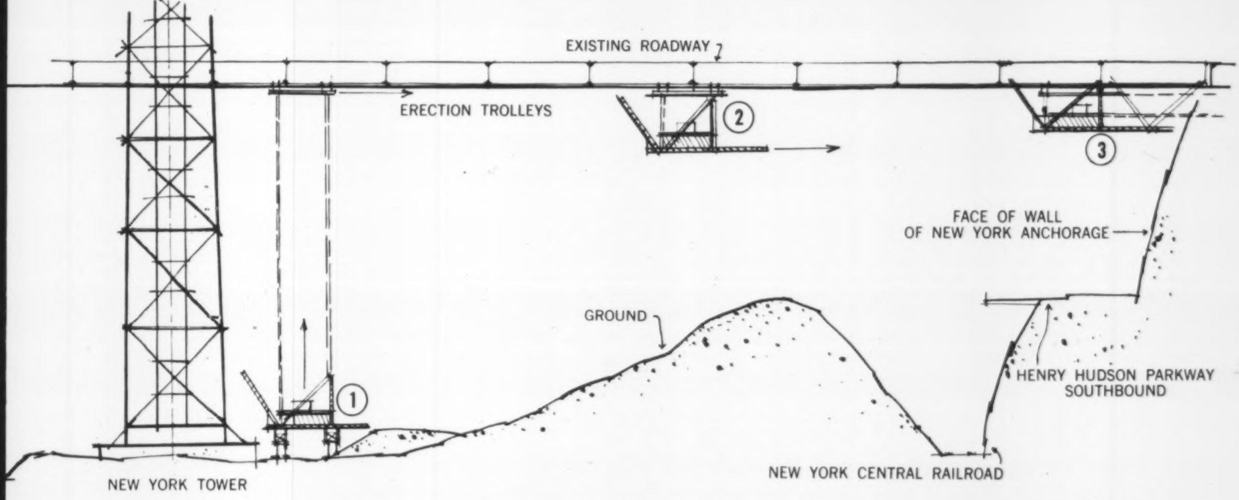
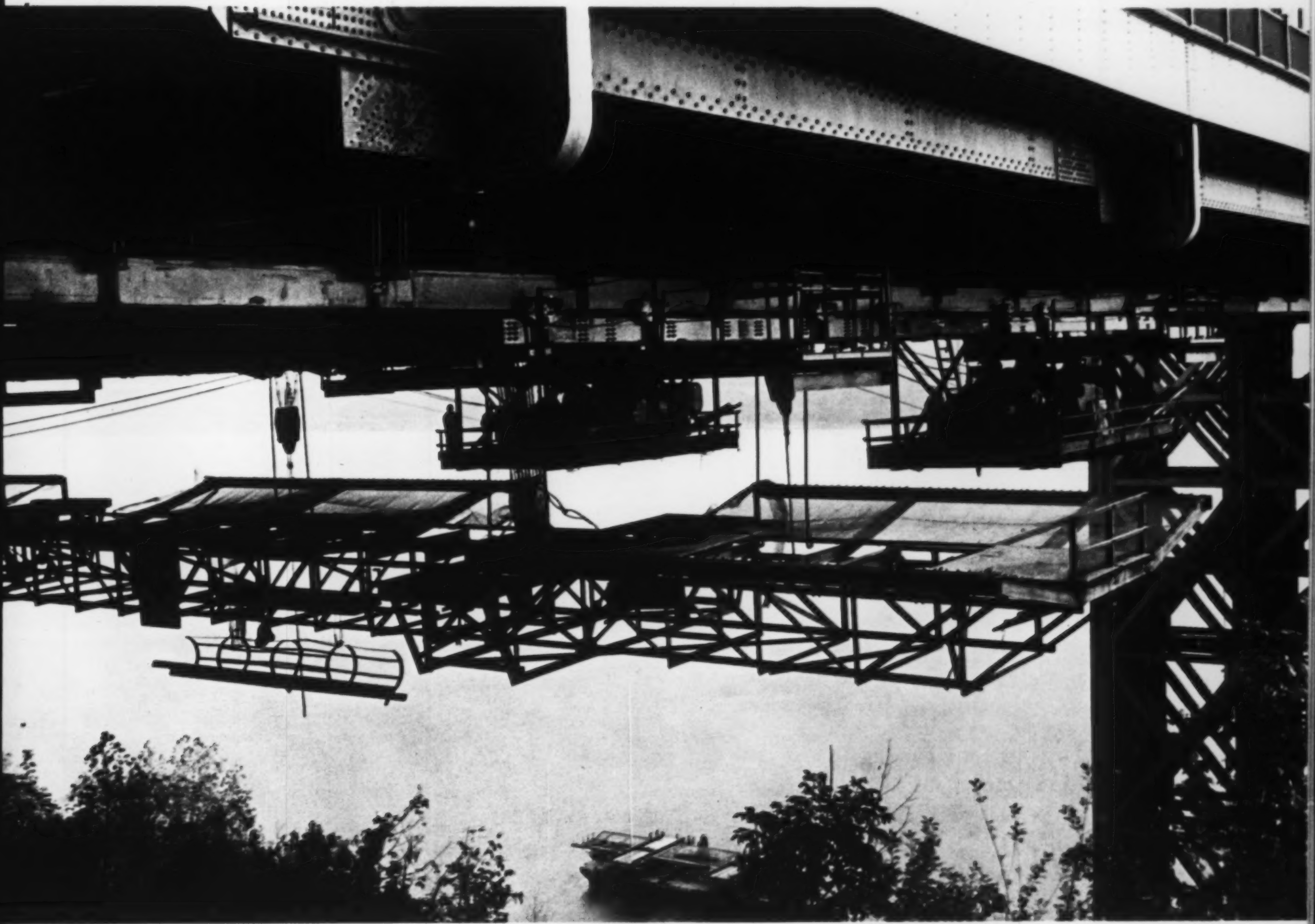

EXISTING ROADWAY
ERECTION TROLLEYS
②
③
FACE OF WALL
OF NEW YORK ANCHORAGE
GROUND
①
HENRY HUDSON PARKWAY
SOUTHBOUND
NEW YORK TOWER
NEW YORK CENTRAL RAILROAD

Diagram of the method used to erect the first truss section. The other seventy-five are being erected in a similar fashion, those for the center span being hoisted from barges anchored in the river. The erection trolleys, complete with hoisting engines, run along 24 WF 76 track beams connected under the bridge floor. These beams will be re-used as stringers for the lower deck.

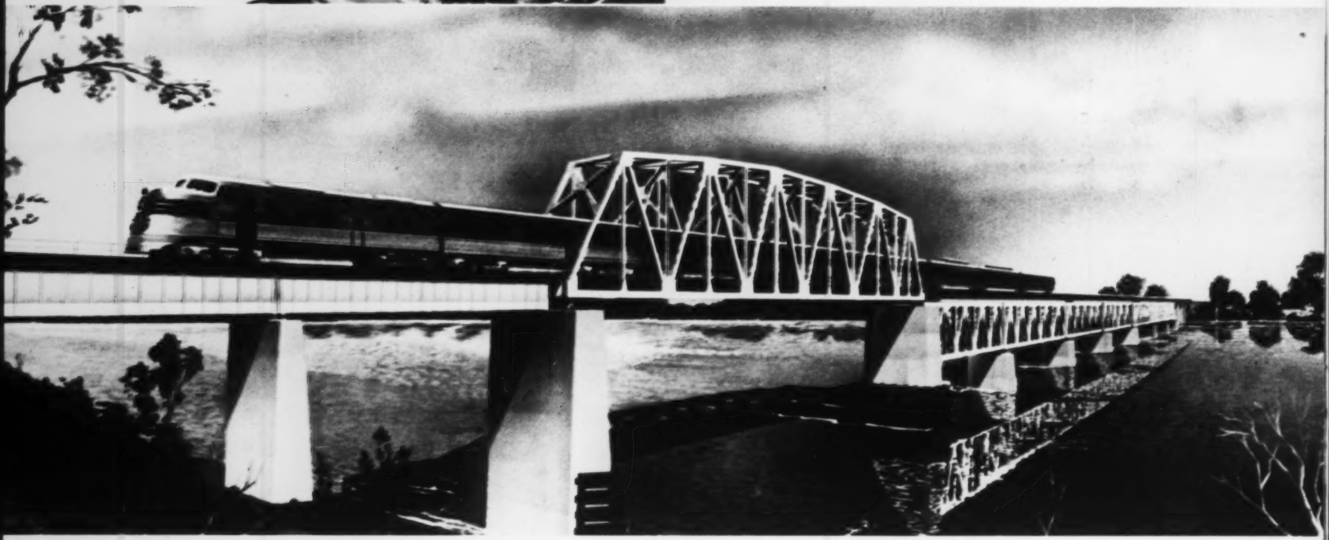


The structure in the foreground is one of the permanent maintenance bridges, as altered for temporary use. These provided access and served as working platforms for the Bethlehem crews assigned to the drilling and other preparatory operations. Another platform can be seen on a barge in the river. Also visible are two hoists mounted on the trolley system. Note at top the drilled gusset plates.

The Tallest in Town

LOS ANGELES—Since repeal of the old height limit, the trend is up, all over town. Newest skyscraper is the 22-story Wilshire-Flower Building, in the downtown area. It's the city's tallest commercial building—269 ft.

Its steel frame, fabricated and erected by Bethlehem, was topped out in January. The structure contains 372,000 sq ft of gross floor area, and required 3,350 tons of structural steel.



Rails Over the River

QUINCY, ILL.—This realistic drawing gives you a good idea of the appearance of the Chicago, Burlington & Quincy Railroad Company's new Mississippi River Bridge upon completion later this year.

Some 2,500 ft long, the new bridge replaces a low-level swingspan structure just to the south. The main span in the foreground provides a 300-ft clear navigation channel, with 63 ft clearance above the normal pool. Not shown are two plate-girder approach bridges to the east, one over Quincy Bay and the other over Route 7. These, as well as the main bridge, are being fabricated and erected by Bethlehem Steel.

The erection scheme calls for the assembly of six deck trusses on barges anchored between the piers. By flooding the barges, Bethlehem bridgemen will ease the trusses onto their anchor bolts. Then they'll erect stringers on the trusses, after which another contractor will place the deck and Burlington construction men will do the trackwork.

The through truss, 336 ft c-c of bearings, will be erected with a floating tower-derrick, assembling the two halves independently on falsework aboard two pairs of barges. Last step will be joining the two halves and landing them on their bearings.

The old navigation channel on the far side of the river will be kept open while construction is under way. The most critical operation occurs when the bridgemen float the last deck truss, complete with trackwork, into position over the old channel and, at the same time, disconnect and float *out* a truss of the old bridge over the *new* channel. Careful planning and teamwork will result in a very brief interruption of rail and barge traffic.

Here's a Sweet Job

SALINAS, CALIF.—It's Nestlé Company's new chocolate plant which will be turning out its delicious products by early 1961.

The main building, shown here, measures 275 by 525 ft with 19 ft of headroom. Those welded, tapered steel girders provide 50-ft spans; purlins span 25 ft between girders. Field connections are made with high-strength bolts. The columns, most of which are 14-in. wide-flange sections weighing from 78 to 84 lb/ft, were field-welded to base plates. Bethlehem's erection crew handled the entire job in four weeks, using only a 25-ton-capacity truck crane.

The building was designed for earthquake resistance, as well as to permit economical future expansion. The long spans and rigid-frame construction provide for flexibility in layout of equipment.

Big Lift for Lawmakers

WASHINGTON—The event pictured here was the hoisting and placing of a heavy truss for the House of Representatives Additional House Office Building.

Weighing about 14 tons, and 36 ft long, the truss is one of 128 required for the new building. All of the steelwork for the structure, totaling some 23,000 tons, was fabricated and erected by Bethlehem.

A few years ago, a short distance away, Bethlehem completed the steelwork for the additional Senate Office Building. This is now occupied by senators who were long hampered by the inadequacy of their former office facilities. Soon the representatives, too, will have roomy, up-to-date working quarters.

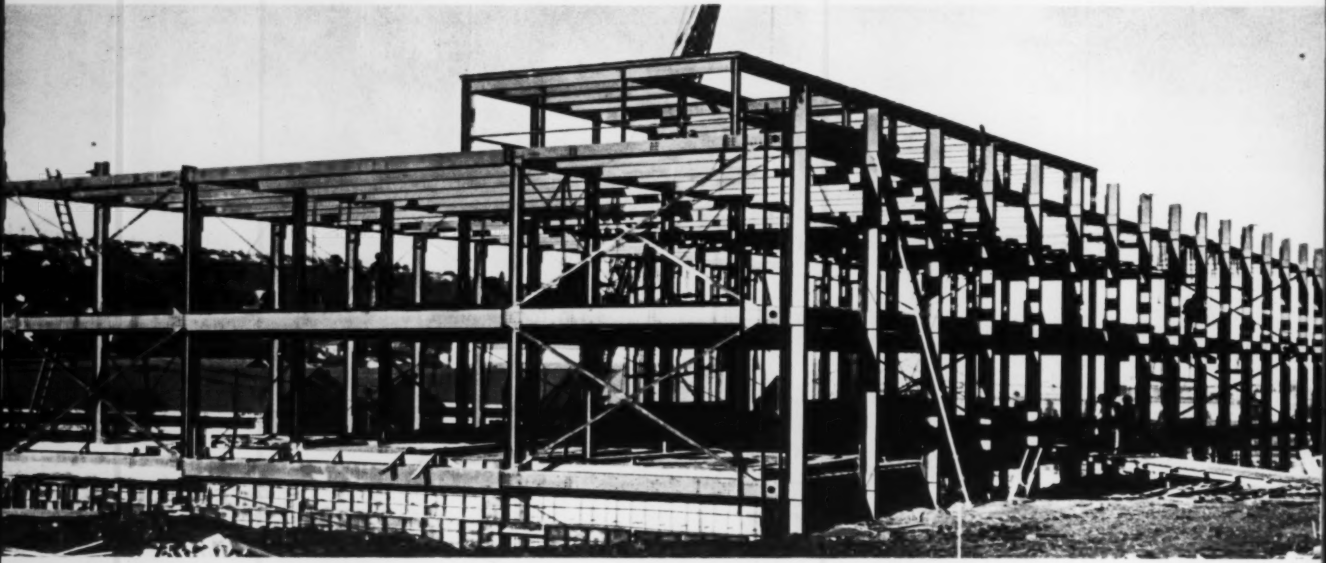
New Office Building for a "New" Steel Plant

SEATTLE—Just a year ago, Bethlehem's "new" Seattle Plant went into full operation. Actually, the plant is an outgrowth of a sixty-five-year-old operation, thoroughly re-built and modernized so that it is today a model of steelmaking efficiency.

With the completion of the building shown here, plant management and office personnel will occupy equally up-to-date office facilities. This building, overlooking the plant, represents the latest word in office design. Its peripheral columns stand outside the curtain walls, thereby avoiding clutter within. The columns will be painted and left exposed, contributing to the architectural effect. The steelwork was fabricated at our nearby Seattle Works, and erected by Bethlehem crews.

An unusual feature of the building is its sun-control system. A photo-electric device will automatically adjust vertical vanes along the entire west side of the building so as to provide adequate shade, yet admit the maximum amount of daylight.

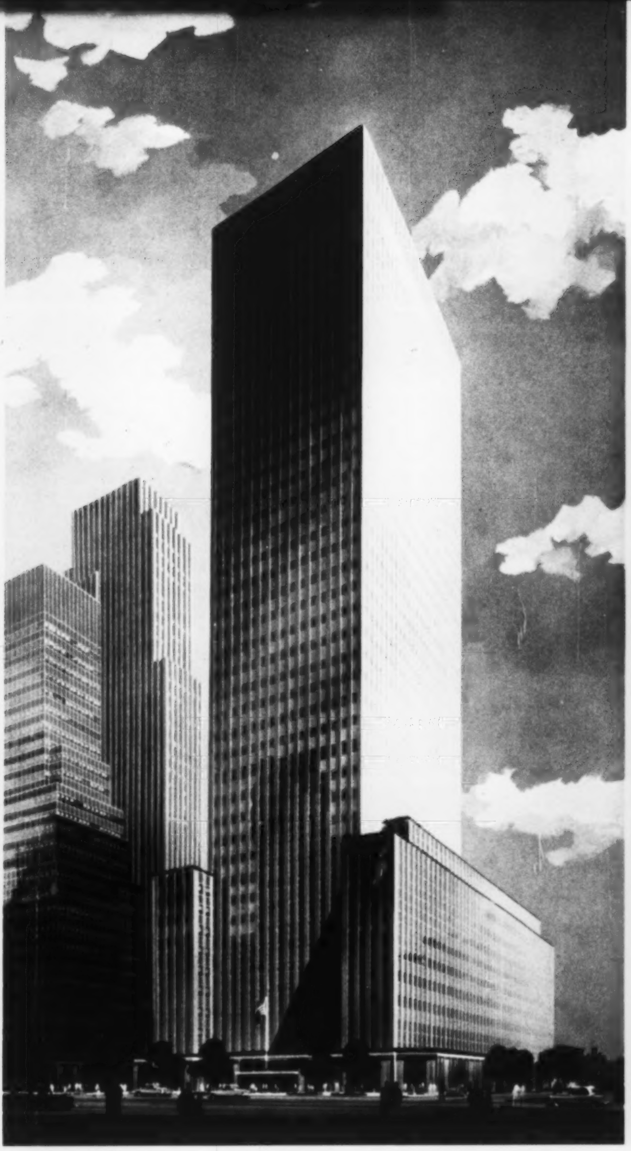
The 150 employees to be housed here, presently located in five widely scattered buildings, include the staff of Bethlehem's Seattle sales office.



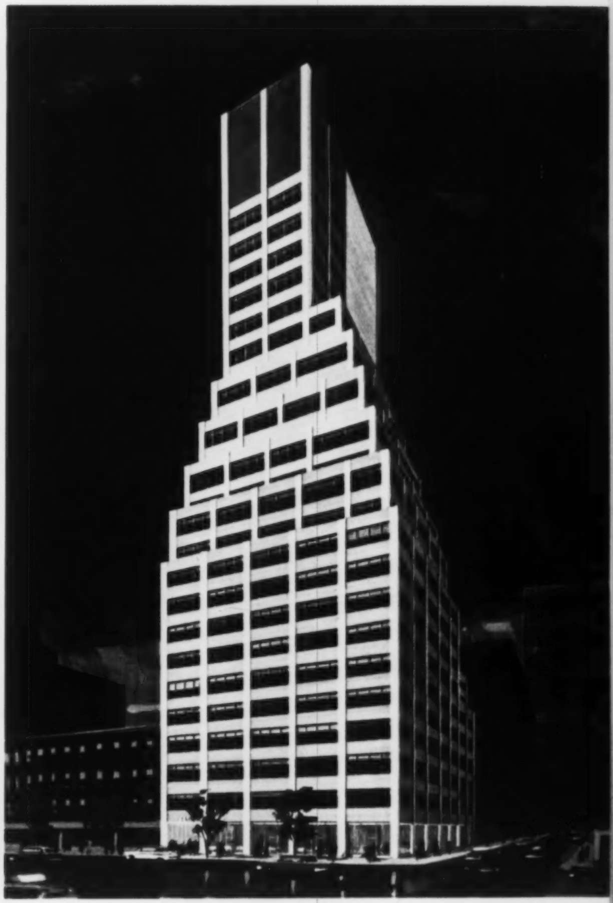
Steel in the Suburbs

WEST SENECA, N.Y.—Suburban shopping centers are growing along with the areas they serve. This steelwork, for instance, is for a major addition to Southgate Plaza, outside of Buffalo.

The two-story building, which will be operated by Sears Roebuck & Company, incorporates the latest trends in fixtures and display facilities. It's to be a complete department store, fully air-conditioned, and will include a public cafeteria and a 14-car service station. Bethlehem fabricated and erected the structural steel framework.



633 Third Avenue



The American Home Products Building

Avenue on the Rise

BETHLEHEM STEEL

NEW YORK CITY—Another chapter in the amazing story of the "new" Third Avenue. Formerly the site of tawdry shops and pubs clustered in the shadow of the old El, Third Avenue is now a broad thoroughfare undergoing a remarkable transformation.

Even before the El had been demolished in 1955, Bethlehem crews were at work on the steelwork for 711 Third Avenue, the avenue's pioneering modern office building. This year, a stone's throw away, work began on two more outstanding structures, the American Home Products Building (685 Third Avenue), and 633 Third Avenue.

The American Home Products Building, on the corner of 43rd Street, will be the headquarters of the well-known firm for which it is named. Twenty-five stories high, it will provide ample office space for the executive and administrative personnel of the parent company and its subsidiaries.

633 Third Avenue, 41 stories, will be located on the east side of the avenue between 40th and 41st Streets. It is the Avenue's second largest office building and one of the biggest to be built in the city since 1945. Much of the 800,000 sq ft of rentable space has already been reserved by blue-chip firms.

CREDITS...

George Washington Bridge Lower Deck	*Owner and operator:* The Port of New York Authority. The final design of the lower deck was developed and its construction is being supervised by the engineering staff of the Authority under the direction of John M. Kyle, Chief Engineer, and I. P. Gould, Engineer of Design. O. H. Ammann, who designed the bridge as chief engineer of the Authority, was also consultant for the design of the lower deck.
Wilshire-Flower Building	*Owner and builder:* Tishman Realty & Construction Company; *architect and engineer:* Victor Gruen Associates and Daniel, Mann, Johnson, & Mendenhall.
Railroad Bridge	*Owner:* Chicago, Burlington & Quincy Railroad Company; *consulting engineers:* Howard, Needles, Tammen & Bergendoff.
Chocolate Plant	*Owner:* Nestlé Company; *engineering and design:* John A. Blume & Associates, Engineers; *general contractor:* Haas & Haynie.
House Office Building	*Architect:* J. George Stewart, Architect of the Capitol; *associate architect:* Harbison, Hough, Livingston & Larson; *structural engineers:* Chester I. Duncan & Son, A. W. Lookup Co., and Sauter & Castor; *general contractor:* McCloskey & Co.
Plant Office Building	*Owner:* Bethlehem Steel Company; *architect:* Bindon & Wright; *structural engineer:* Anderson-Bjornstad-Kane; *general contractor:* John H. Sellen Construction Co.
Department Store Building	*Owner:* Southgate Plaza, Inc.; *architect and engineer:* Joseph J. Geigand.
The American Home Products Building	*Owner and builder:* Sam Minskoff & Sons; *architect:* Robert L. Bien; *structural engineer:* Weinberger, Frieman, Leichtman & Quinn.
633 Third Avenue	*Owner:* Galbreath-Ruffin Realty Company, Inc.; *architect:* Harrison & Abramovitz; *builder:* Turner Construction Company.

NEW CONSTRUCTION LITERATURE—FREE OF CHARGE

Booklet 549	*The Chase Manhattan Bank Building*—24 pages, partly in full color. A picture story of the fabrication and erection of steelwork for a magnificent, 60-story office building.
Booklet 527-A	*The Welding of Concrete Reinforcing Bars*—A 20-page booklet describing the recommended procedures for welding reinforcing bars, with sketches and joint details.
Catalog 493	*Wire Rope for Construction and Industrial Equipment*—A 150-page catalog containing specific recommendations for the use of Bethlehem wire ropes on various types of construction and industrial equipment. It also includes basic wire rope information, as well as detailed data on standard Bethlehem ropes and fittings.

Also: a number of publications and article reprints are available describing outstanding light-occupancy structures designed with structural steel frames: homes, schools, commercial buildings, churches. Just ask for literature on "light steel framing."

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Booklet 552

605 Printed in U.S.A.

JOB REPORT: *NELSON Stud Shear Connectors in Composite Construction*

COMPOSITE *STEEL-CONCRETE*
CONSTRUCTION*

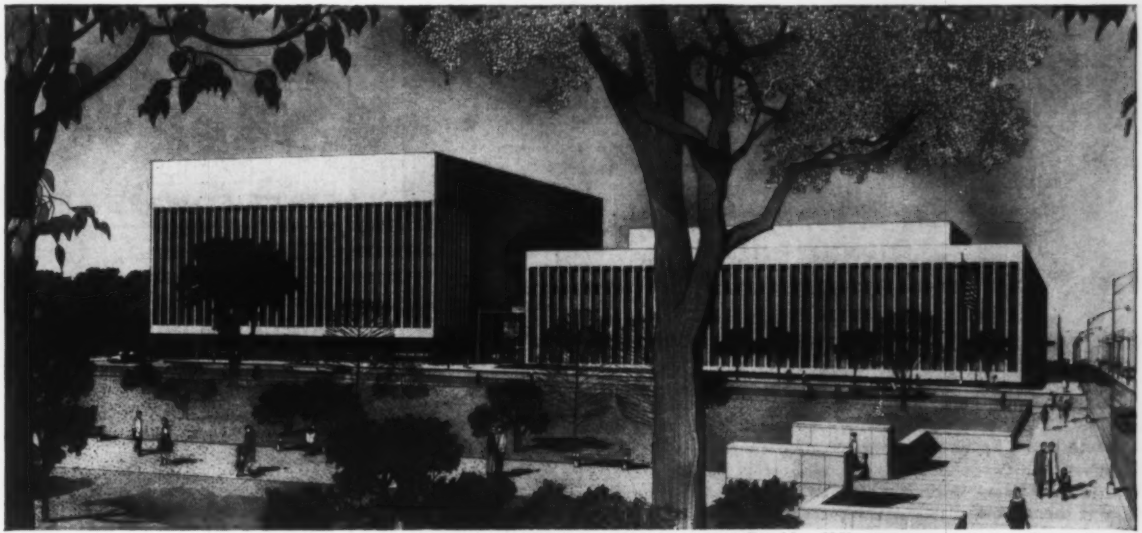
...in new Federal Court House

Composite construction will cut 20% to 25% from steel tonnage, according to structural engineering consultants Seelye Stevenson Value & Knecht. The project, now under construction, is the new court house and Federal office building in Brooklyn, N. Y.—the largest building ever to employ this modern design concept...

**A steel and concrete composite beam is made up of three essential elements: A steel beam, a reinforced concrete slab, and shear connectors. Horizontal shear is transferred to the beam through the shear devices which join the slab to the beam in such a way as to cause the concrete and steel elements to act as a unit.*

Although Composite Construction for buildings is relatively new (it has been used in bridge design for over three decades), many engineers and architects use it to gain these economies and advantages over non-composite construction... *shallower beams*—to meet equal load requirements • *reduced over-all cubage*—economies in materials • *longer spans*—greater load-carrying capacity per pound of steel • *wider spacing of columns*—more unobstructed floor space.

A *free* copy of the engineering story behind this Federal Court House project is now available. Call in your local Nelson Man, or write for "Record For Composite Construction", Nelson Stud Welding, Division of Gregory Industries, Inc., Dept. 10, Lorain, Ohio.



FEDERAL COURT HOUSE AND OFFICE BUILDING, Brooklyn, N.Y.—**Associated Architects:** Carson & Lundin, Lorimer & Associates • **Structural Engineers:** Seelye Stevenson Value & Knecht • **General Contractors:** P. J. Carlin Construction Co. and Atlas Tile & Marble Works • **Shear Connector-Applicator Contractor:** W. R. Johnson, Jr., Associates, Inc.

NELSON Stud Shear Connectors *are approved by the AASHO for bridge construction.*

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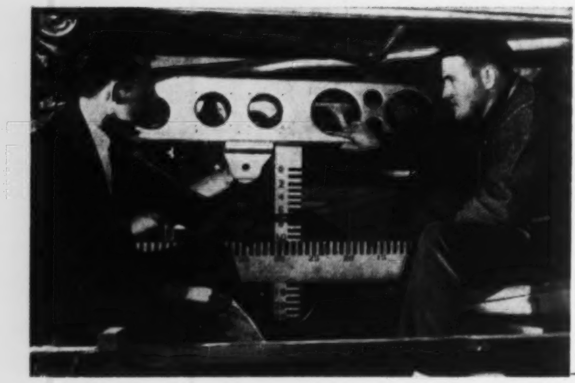

Darrell George (left), vice-president of the Student Chapter at the University of Oklahoma and Max Baccus, president of the Student Chapter at Oklahoma State University, stop at Vicksburg en route to the New Orleans Convention to examine facilities for vehicle mobility research at the Waterways Experiment Station. The two schools were represented at the Convention by a large group of seniors, graduate students, and faculty members. The trip was sponsored through the efforts of ASCE Director W. W. Baker.

Annual spring meeting of the Spokane Section, held under joint sponsorship of the Student Chapters at the University of Idaho and Washington State University, featured presentation of student papers. Taking part (left to right) are Ladin Delaney, W.S.U.; Harry Drake, Contact Member from the Columbia Section for W.S.U.; Larry McTigue, W.S.U.; Loren B. Almy, president of the Spokane Section; Robert Thompson and Leo Tafolla from U. of I.; Harold Stivers, Contact Member from the Columbia Section for U. of I. and Robert N. Tucker, outstanding senior at U. of I.

Three prominent Arizona engineers and past presidents of the Arizona Section received 75th Anniversary Medallions of Merit from their alma mater, the University of Arizona, at a Section luncheon meeting. John C. Park (right), dean emeritus of the Engineering College of the university, presents the medallions to (left to right) Wayne G. O'Harra, Earle V. Miller and Ralph A. Hoffman, for outstanding contributions to the state and to university research and education.

CIVIL
ENGINEERS

ASCE CONVENTIONS

RENO CONVENTION

Reno, Nev.
June 20-24, 1960

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

PHOENIX CONVENTION

Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

DISTRICT CONFERENCES

PACIFIC SOUTHWEST COUNCIL

Reno, Nev.
June 20-24, 1960

TECHNICAL DIVISION MEETINGS

WEST COAST CONFERENCE ON APPLIED MECHANICS

Pasadena, Calif.
California Institute of Technology
June 27-29, 1960

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HYDRAULICS CONFERENCE

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BY-LINE WASHINGTON . . . . .

Some government-employed engineers and technicians—and practically nobody else—are behind that new bill in Congress which would set up a system of federal registration of engineers and scientists, and the new title of "Federal Engineer."

Take note, at once, that the **bill (H.R. 11916)** is rated as having absolutely no chance of action. It should also be noted that Rep. John R. Foley (D.-Maryland) introduced the bill "by request"—which is a Congressional way of saying that he did it to please a constituent, and doesn't really care, personally. But the idea of some such federal registration is not a new one, and the present bill could pave the way for another, and better-drawn, measure at the next session, so it's worth attention.

In a nutshell, the measure would set up a seven-man **federal registration board** (which would include civil, mechanical, electrical, and chemical engineers) that would have the power to qualify, by examination or otherwise, engineers and technicians for the title "Federal Engineer." Note the inclusion of the word "technician"—the grade is defined in the bill as, "a candidate for registration . . . who has been schooled or completed an apprenticeship in the useful mechanical arts, has knowledge of the practice, method or procedure in science, trade profession or art. No one who is skilled in technique."

The real teeth in the bill—and the one that would affect all engineers, in and out of the government—are contained in Section 105, ". . . it shall be unlawful for any person to engage, or offer to engage, in the practice of engineering . . . on federal projects, or projects sponsored by the federal government . . . unless such person is registered under this act." [Copies have been sent by Executive Secretary Wisely to appropriate ASCE committees. *Ed.*]

* * *

A strong case could be made for **consultant inspection of road projects,** out of the hearings into the Interstate Highway Program before a special House public works subcommittee (the Blatnik Committee) early in May. The key point in the testimony—aside from implications of some local wrongdoing—was the extremely poor supervision and testing by the Oklahoma Highway Department inspection staffs, during construction of the so-called "Skelly bypass" around the southeastern portion of Tulsa. Committee investigators stressed the point that, although the roadway stood up reasonably well under traffic, it did not contain the specified thicknesses of base and subbase shown in the design.

* * *

Consultants serving as individuals with government construction agencies may get a long-sought "raise," it now appears, as a result of a quiet campaign by the agencies themselves. A new **Senate bill (S.3488),** sponsored by Arkansas's powerful John McClellan, would raise the fees from the present **$50** to **$100** per day (plus the **$12** per day allowance for travel and other expenses). Construction agencies have long argued that **$50** a day is so small a fee for top consultants that such men are, in effect, donating their services at a loss to themselves, and have been reluctant to accept such assignments. The bill is also approved by the Bureau of the Budget.

And on the subject of **employing outside consultants,** the Corps of Engineers, testifying before the House Committee on Space and Astronautics, took occasion to comment that 94 percent of its total engineering work—including both military construction and civil works—is done by its own staff. Overall, said Lt. Gen. E. C. Itschner, the Corps spends a little over 5 percent of its money for all engineering design, supervision, and overhead.

Final regulations concerning outside engineering work by employees of the Bureau of Reclamation haven't yet been issued, but—under control procedures issued more than a year ago—the practice has been effectively stopped, according to Reclamation Commissioner Floyd Dominy. Engineers will recall the fuss last year over outside employment of many engineers in the Bureau's Denver office. Commenting on this matter (to the House Appropriations Committee), Commissioner Dominy said, the following rules are now in effect: (1) Outside work not involving technical skills used in regular Bureau duties may be approved, provided it isn't in conflict and doesn't interfere with regular duties; (2) outside work involving technical skills used in regular duties may be approved only for GS-11 employees and below (surveyors and lower grade employees); (3) a time limitation of 15 hours per week is imposed under either of these approvals; (4) outside work is prohibited on a specified list of projects—including those financed by foreign aid funds, or where licenses or other permission must be granted by the federal government.

* * *

Announcement of the two-year extension of **Lt. Gen. E. C. Itschner's term as Chief of Engineers** is again a compliment to General Itschner, as was his recent promotion to three-star rank. Extension of a chief's term has been relatively rare in peacetime, but it has occurred before.

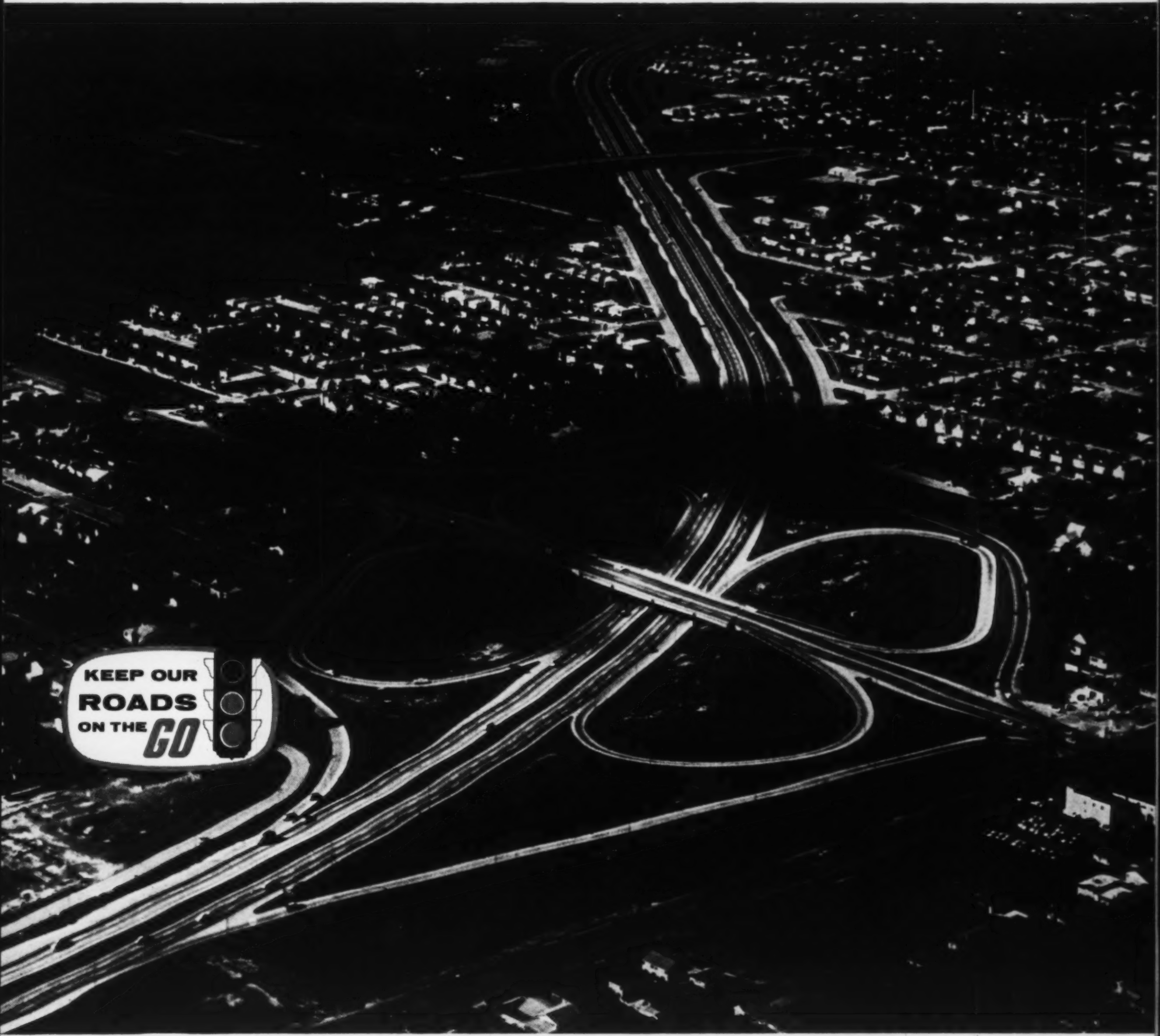
* * *

Look for some Senate attempts to change Bureau of Reclamation regulations concerning use of **power revenues derived from reclamation projects,** such as Grand Coulee. At Senate Appropriations committee hearings on Bureau of Reclamation funds, Senators Ellender and Dworshak expressed themselves as "greatly disturbed" to find that Coulee's power revenues were "mortgaged" far into the future to pay for further irrigation developments. Ellender (who's from non-reclamation Louisiana) said he'd "look into" the matter seriously. He thought, he said, power revenues went into the general treasury, after facilities were paid for.

* * *

There is nearly a billion dollars worth of **future construction work,** including architecture and engineering, in that group of 106 public buildings approved by the Senate Public Works committee, at the General Service Administration's request. A total of 78 projects will be for new structures, the rest for major modification and repair. The next step is to get appropriations to start design. The GSA figures it takes about two years from the time it gets the money until it is ready to seek construction bids.

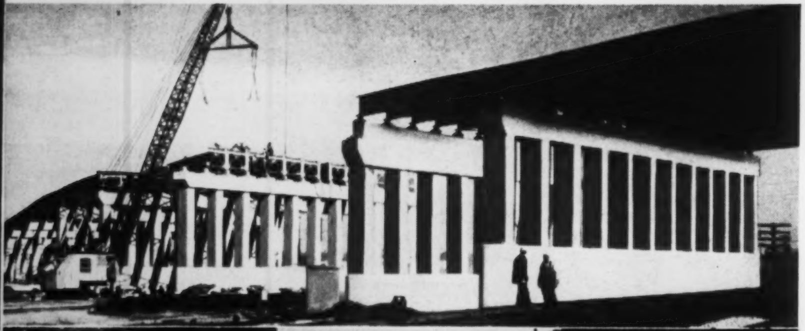
Interstate road construction on the go in Illinois


KEEP OUR
ROADS
ON THE GO

Interchange of U.S. Route 41 and Touhy Avenue in Lincolnwood, Cook County

Additional story and pictures on following pages ▶

Illinois builds 1,608 miles of

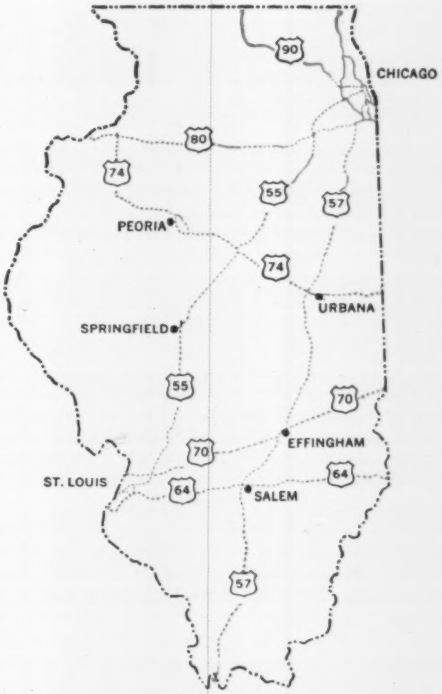


Left and above: Here are two of 2257 new bridges being built in Illinois. New bridges often carry traffic *over* previous bottlenecks, make for safer driving conditions, cut traveling time. In some cases creek or river beds are being altered so bridges can be placed in better locations. Many new bridges speed up traffic flow, are replacing old, narrow and unsafe structures. In most cases, USS Structural Steel offers the fastest most reliable and economical method of construction.

Culverts made from USS Galvanized Culvert Sheets are ideal for highway drainage. They completely absorb forces of impact and vibration, so they are excellent for use in high-traffic areas. Strict quality control through every step of production assures long life and dependable performance. Culverts shown here are on Interstate Route 74 in east-central Illinois.

Interstate roads

Products of U. S. Steel help keep Illinois roads on the go



Illinois Interstate Highway network. Solid green lines indicate completed mileage or mileage under construction. Green dots are planned mileage or existing Illinois highways that will later go into the Interstate Program.

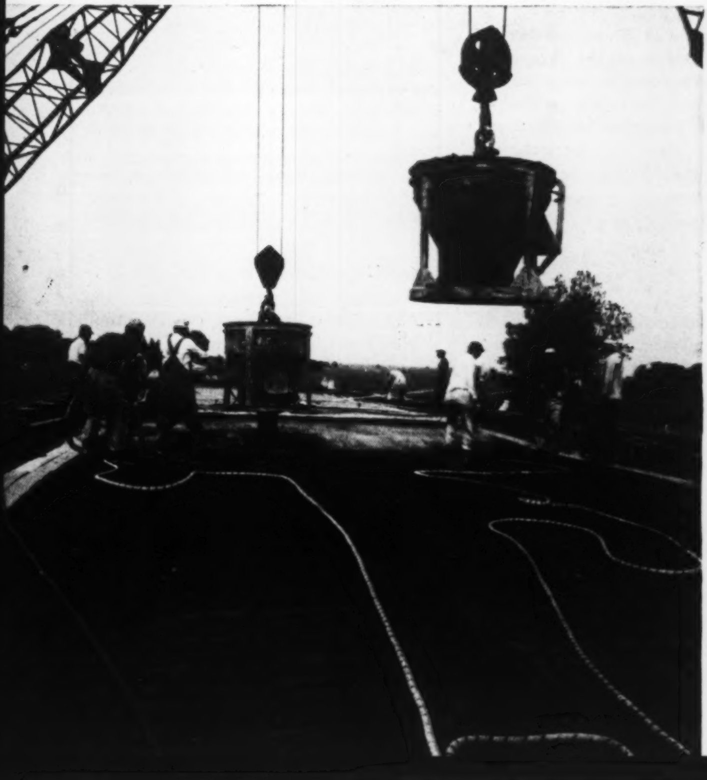
Across the rolling prairies of Illinois a wide spiderweb of new highway construction is growing day by day. According to the Interstate Cost Study prepared by the Division of Highways of the State of Illinois in 1957, the estimated cost of 1,608 miles of new interstate roads and approximately 2,260 bridges in Federal and State funds would be $2,265,573,000. Already, 234 miles of road and 404 bridges have been completed, and under construction today are 140 more miles of road. This new highway network is part of the greatest building project of all time—the nationwide Interstate Highway System. It will relieve congestion and improve the safety record of roads in this rich agricultural-industrial state.

U.S. Steel provides much of the material for the Illinois road-building program. Cement, slag, reinforcing bars and welded wire fabric go into the highways and high-strength and constructional alloy steels, sheet piling, tubular piles go into bridges; drainage products made of USS corrugated galvanized culvert sheets or concrete carry away excess water. Wire rope, cable, tubing and special steels go into the construction equipment that moves the mountains of earth and lays the right of way. For safety, USS furnishes fence, beam and cable guard rail, steel for signs.

USS, AmBridge, DI-LOK and VITRENAMEL are registered trademarks

USS United States Steel

The highway market is served by the following divisions of United States Steel: American Bridge Division, Pittsburgh, Pa.; American Steel & Wire Division and Cyclone Fence Dept., Cleveland, Ohio; Columbia-Geneva Steel Division, San Francisco, Calif.; Consolidated Western Steel Division, Los Angeles, Calif.; National Tube Division, Pittsburgh, Pa.; Tennessee Coal & Iron Division, Fairfield, Ala.; Universal Atlas Cement Division, New York; United States Steel Supply Division, Steel Service Centers, Chicago, Illinois.



These men direct the Illinois highway building program (left to right):

William G. Stratton, Governor of Illinois.

Edwin A. Rosenstone, Director of Illinois Department of Public Works and Buildings.

Ralph R. Bartelsmeyer, Illinois Chief Highway Engineer & Immediate Past-President of the American Association of State Highway Officials.

Workmen pour concrete for bridge surface on Interstate Route 55. U.S. Steel supplies DI-LOK reinforcing bars for concrete construction as well as Steel Sheet Piling, USS Steel H-Piles, and Structural Carbon, Alloy and High-Strength Steels for the bridge itself.

KEEP OUR
ROADS
ON THE GO

*Write for the **free** 54-page booklet, "Keep Our Roads on the Go." You'll find all the United States Steel products and services that will help you cut costs and speed operations in highway construction. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.*

News Briefs . . .

AWWA Holds Eightieth Annual Meeting

Members of the American Water Works Association, meeting in Miami Beach in late May, were told that the cost of works construction for the next twenty years will be $24 billion; they were challenged to produce not just safe water but quality water; they heard a proposal for a research institute in the water field; installed C. F. Wertz, F. ASCE, as president, and recognized three honorary members. Fine weather and water competed with an excellent technical program; each had plenty of adherents.

Outgoing President Lauren W. Grayson, F. ASCE, general manager and chief engineer of the Public Service Department of Glendale, Calif., told some 3,300 attending the convention: "Our water systems are deficient because we have failed to keep pace with the economy of our country; we have failed to grow with population growth; we have failed to present adequate programs before the proper people to enable work projects which are now desperately needed to go forward.

"The evaluated deficiencies in our public water supply systems appear to need an expenditure of $5 billion for correction. If these were all completed in ten years, the average cost per person would be less than $4 per year. The estimated cost of new construction in public water supply systems to keep abreast of increasing demands and population growth between now and 1980 is $24 billion. . . . The water industry should be spending annually more than three times the $400 million expended in 1959. . . . An ample supply of quality water for every community would cost only about 4 cents per capita per day on the average."

Ray J. Faust, F. ASCE, secretary of AWWA, reported that: "One of five water utilities is deficient in supplies; two of five are deficient in transmission capacities; one of three is deficient in pumping capacity; two of five are deficient in treatment capacity; ground and elevated distribution storages show deficiencies of 29 percent and 43 percent, respectively; distribution system improvements are required in 57 percent of the water systems."

Commenting on the fact that water generally is safe, Mr. Faust stated: "The water industry needs a standard with a broader or higher objective—a standard that carefully considers the other desirable aspects of water. For example, the U. S. Public Health Service Drinking Water Standard allows up to 10 ppm of turbidity in water supply. . . . Currently a well operated filter plant can easily produce a finished water with 1.0 ppm, 0.5 ppm, or even 0.2 ppm or less of turbidity." Mr. Faust further advanced the idea that the test of quality water should be determined on samples collected from the consumer's tap and not from the plant effluent. This plan requires that the distribution system be kept clean—a lot cleaner than many systems are kept today.

Commenting further on water quality standards from the viewpoint of the operator, John R. Baylis, M. ASCE, of the Department of Water and Sewers, Chicago, recommended some kind of a grading system in filtration plants. He commented that few cities would tolerate Grade B water. Of some comfort to engineers may be his comment that, "Engineers are being given more chemistry in college than in the past but still choose to call themselves engineers. For some unknown reason, an engineering title often pays more money than a chemical title for the same quality of work to be done."

C. F. Wertz (left), director of the City of Miami Department of Water and Sewers and new president of the American Water Works Association, receives the good wishes of retiring President Lauren W. Grayson, of Glendale, Calif. Both are ASCE Fellows. New officers were installed during the AWWA's recent conference in Miami. Photo courtesy of Miami-Metro News Bureau.

Alkyl benzene sulfonate (ABS), household detergents and commercial cleansers are contaminating underground waters, Graham Walton, of the Taft Sanitary Engineering Center, Cincinnati, told a technical session. Chemical contamination of ground water is far more serious than similar contamination of surface water. Underground water moves but a few feet per day, and years may pass before the contamination is detected. Once it occurs, it may be many years before the ground water is again free from contamination. An extreme example is a plant that was in operation for one month only, yet contaminated a municipal well supply for a period of four to five years.

A symposium on water main breaks brought out that there is room for improvement in every kind of pipe. Thicker pipe, shorter lengths, and better joints seem to be important factors. More failures occur in the winter months when frost penetration transmits surface shock to greater depths. Many occur in the early morning hours when pressure may be high. Areas where there are abandoned street car tracks are especially subject to exterior corrosion. There is little evidence that internal corrosion is responsible for water main breaks. Proper handling of materials to avoid damage, good laying techniques, and proper backfill are believed to be most effective in preventing breaks. Unequal settlement of the soil in which the main is laid, especially on subway routes in New York, and crossings of other utilities underground are a frequent cause of difficulty. Water hammer is classed as a low factor in difficulties with mains but temperature ranks very high. In one case, use of water pump wells, which raised the average temperature 5 degrees, alleviated greatly the number of breaks in the system.

A proposal was presented to the convention that a research institute be established within the AWWA to study needs and uses of water.

Honors Conferred

Honorary memberships in the AWWA were conferred on Raymond Johns Faust, secretary, American Water Works Association; Edward Roy Stapley, dean emeritus, College of Engineering, Oklahoma State University; and Paul Weir, manager, Atlanta Water Department. All are members of ASCE. C. F. Wertz, director of the Department of Water and Sewers, Miami, Fla., was installed as president of the organization, succeeding Lauren W. Grayson. The new vice president is John W. Cramer, F. ASCE, partner in the consulting engineering firm of Fulton and Cramer, of Lincoln, Nebr. William J. Orchard continues as AWWA's treasurer.

Underwater Storage Facility

Oceanographers, underwater drilling experts, engineers, and storage authorities have teamed up to select a site off St. Petersburg Beach, Fla., for the first underwater storage facility of its kind. The waters of the Gulf of Mexico will soon house storage tanks for a wide variety of liquid and solid materials. A private industry group, headed by Reed Chunn, of the Firestone Tire & Rubber Company, will soon start work on prototype tanks for the project.

The pilot installation will consist of several collapsible tanks, which will be set into special cradles anchored to the bottom of the Gulf, from 40 to 200 ft below the surface. The materials used are rubber-impregnated and coated fabrics impervious to the elements. The tanks can withstand hydrostatic pressures, and the contents are kept at a mean temperature.

Once in operation, the installation will be available for private and government use anywhere in the world.

Builders Chosen for Columbia Lock and Dam

A joint-venture group of three construction companies will build the Columbia Lock and Dam on the Chattahoochee River near Columbia, Ala. The combination consists of the Winston Brothers Company, of Minneapolis, Minn.; the Green Construction Company of Des Moines, Iowa; and the Tecon Corporation, of Dallas, Tex. Announcement of the award of the $8,918,861 contract has been made by Col. R.W. Love, U. S. Army District Engineer at Mobile. The joint venture submitted the lowest of the fifteen bids received.

The structure will consist of a lock with inside dimensions of 82 by 450 ft and a maximum lift of 25 ft, a gated spillway with four tainter gates, and a fixed-crest spillway. It will back up the river, largely within its present banks, to form a 9-ft navigable channel from the upper limit of the Jim Woodruff reservoir to the Walter F. George Lock and Dam, a distance of about 28½ miles.

The Columbia Lock and Dam is the last of four dams being built by the Corps of Engineers in the current comprehensive development of the Apalachicola-Chattahoochee-Flint river system. With its completion in 1963, together with concurrent completion of the Walter F. George Lock and Dam, a 9-ft barge channel will become available from the Gulf Intracoastal Waterway at Apalachicola, Fla., to Columbus, Ga., and Phenix City, Ala. The channel is already in use from Apalachicola to Bainbridge, Ga., on the Flint River and to Columbia on the Chattahoochee. Other benefits from the project will be flood control in the upper Chattahoochee Valley, hydroelectric power, streamflow regulation, and the formation of three large lakes for recreation.

Utica Auditorium Features New Lightweight Roof

A memorial auditorium, opened in Utica, N. Y., in March, features two world "firsts," which may have far-reaching effects on design and construction of long-span buildings. One is a prestressed dual-cable suspension roof reminiscent of the suspension bridge; the other, a unique installation of telescoping seats around the perimeter of the arena floor which provides for great flexibility of function.

The roof system, designed by engineer Lev Zetlin, M. ASCE, eliminates the flutter usually associated with cable construction. Although 72 tons of steel cable were used in the Utica project, the complete weight of the roof—including cables, roofing, and separators—is only 14 psf. In conventional construction, a roof for this type of building would normally weigh from 40 to 50 psf.

In addition to savings in construction costs, the prestressed dual-cable system provides other benefits. In the Utica Auditorium, for example, a completely unobstructed view may be obtained from every seat in the building.

The seating itself is also a feature of the new auditorium. The building contains 3,200 permanent upholstered auditorium chairs, 2,300 portable chairs, and a special innovation—1,000 upholstered telescopic seats. When not in use, these seats can be folded back into pockets concealed in the wall, much like the old Murphy bed. Their design is such that they can be used or stored without restricting the flexibility of the structure.

The circular construction has resulted in a single room with a ceiling effect similar to that of a gigantic bicycle wheel. Two sets of 72 cables are connected at the outside to a concrete compression ring which also forms the top of the exterior walls, and to two steel tension rings in the center.

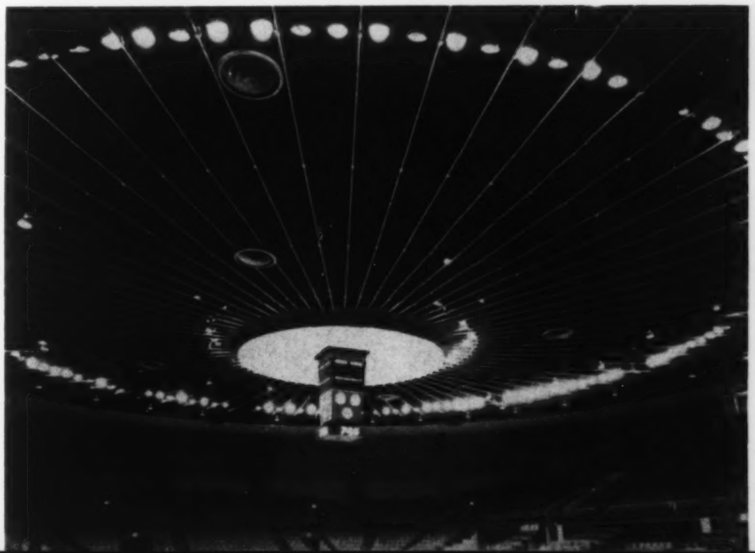
"The suspended roof structure makes use of the fact that the ideal economical steel span is a cable," according to Gilbert L. Seltzer, head of the Gehron & Seltzer architectural firm that designed the auditorium. "In the past, the use of cables for this purpose invariably resulted in flutter. This problem has been eliminated by a compression action designed into the roof as an integral part of a milder pretensioning operation."

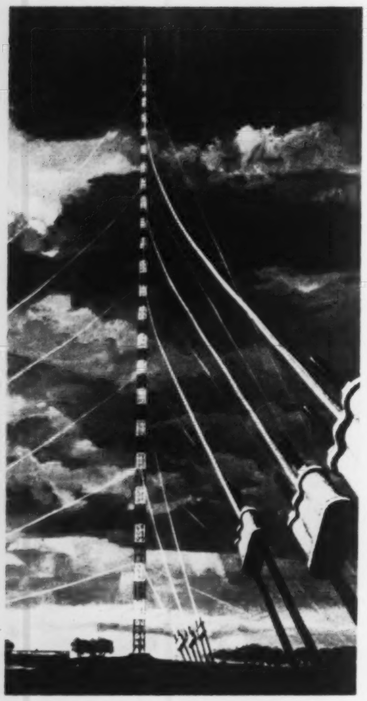
In the Utica Memorial Auditorium system, a compensating series of cables was stretched above and below the compression ring so that each series acts as a dampener for the other. Therefore, there is no change in the horizontal pull on the compression ring when a load is added because horizontal components cancel out. Roof decking, equipment, and snow increase the tension in the upper cable and decrease the tension in the lower one. By creating a sufficiently large initial force in the upper cable, this tension will never be reduced to zero and the cable will never go slack.

Above the cables is a corrugated steel decking, topped by insulating boards. The outer surface is a conventional roofing of felt impregnated with asphalt and covered with gravel.

Fred S. Dubin Associates were the mechanical and electrical engineers on the Utica Memorial Project. The general contractor was the Sovereign Construction Co. Ltd. Lev Zetlin, of New York City, was the civil engineer.

A gigantic bicycle wheel effect, featuring 3½ miles of steel "spokes" weighing 72 tons, has been achieved by architects Gehron & Seltzer for this unique roof at the new Utica Memorial Auditorium. Engineer Lev Zetlin M. ASCE, designed the prestressed dual cable suspension roof for the structure—a system that eliminates the "flutter" usually found in structures utilizing cables.





THE WORLD'S TALLEST STRUCTURE

Under construction at Cape Girardeau, Mo., is the world's tallest structure, a television transmitting tower to rise 1,676 ft above the ground. The tower, for station KFVA-TV, will beam a signal to a 31,800-sq mile area. It is triangular in shape and stands on a concrete base and is held by 18 guy lines. Load on the base is over 1,000 tons, from the weight of the structure and the force of the cables. Design and construction of the tower is being done by Dresser-Ideco Co., of Columbus, Ohio, one of the Dresser Industries.

The structure will be 692 ft taller than the Eiffel Tower and 204 ft higher than the television antenna on the Empire State Building. Its base is on a hill at El. 810 so it reaches El. 2,486 above sea level. A service elevator within the tower will require 25 min for ascent. The Russians are said to be building a TV tower 1,667 ft high.

Waste Treatment Conference at Manhattan College

Informal discussions sandwiched between formal sessions are an attraction of every scientific meeting, and this was the case at the Third Biological Waste Treatment Conference held at Manhattan College, April 20-22. Pictured enjoying a break in the schedule are, left to right, Eugene Weisberg, Pantech Engineers, Pittsburgh, Pa.; H. Heukelekian, chairman of the Department of Sanitation, Rutgers University; Chester C. Kisiel, A.M. ASCE, instructor in sanitary engineering at the University of Pittsburgh; and Brother Joseph McCabe, F. ASCE, head of the Manhattan College Department of Civil Engineering. Eight foreign countries were represented in the attendance of 300 engineers and scientists who gathered to learn about advances in the field of sanitary engineering. Prof. W. W. Eckenfelder, M. ASCE, was conference chairman. Photo courtesy Conrad Waldinger.

Chi Epsilon Holds Biennial Conclave

The Michigan College of Mining and Technology at Houghton, Mich., was host to the 16th Biennial Conclave of Chi Epsilon Fraternity, April 21-23. Most of the 50 Chapters—from the new state of Hawaii to Massachusetts and from Texas to the Great Lakes—sent delegates. Prof. Paul Hartman, F. ASCE, of the College of the City of New York, was elected president for the next biennium, and Prof. Marion B. Scott, M. ASCE, of Purdue University, was elected vice president.

The fraternity will celebrate its 40th anniversary at Urbana, Ill., in 1962.

Arizona Is Awarded Colorado River Water

In a historic ruling that may change the entire look of the Southwest, Special Master Simon H. Rifkind has divided the waters of the lower basin of the Colorado River among five states and the federal government. His decision, depriving California of 978,000 acre-ft of water a year, gives Arizona the victory in a bitter fifty-year fight between the two states.

Judge Rifkind, a New York City attorney, was appointed special master by the United States Supreme Court to conduct the two-year Colorado River case. The trial was the fifth in a series filed by Arizona against California. The parties to the suit may file objection to the decision, but in such complicated cases the court usually upholds the recommendations of its special masters.

Out of an annual flow of 7,500,000 acre-ft below Lee's Ferry, Ariz., Judge Rifkind apportioned 2,800,000 acre-ft for use in Arizona, 4,440,000 acre-ft for California, and 300,000 acre-ft for Nevada. New Mexico and Utah would receive minor allocations, as would eight Indian reservations and wildlife refuges. Any mainstream surplus, after these allocations, would be divided equally between California and Arizona. Judge Rifkind ruled that, in times of short supply, Arizona, California, and Nevada would suffer in proportion to their allocations. Thus California, with the largest allocation, would be worst off.

Experts at the trial testified that the available flow at Lee's Ferry is frequently less than the 7,500,000 acre-ft apportioned, which could mean that Southern California's aqueduct system might have to operate at half capacity or could even go dry. Thus the decision may be a spur to the Feather River Project, a plan for bringing water to Southern California from the Sacramento area. For Arizona, Judge Rifkind's ruling would make possible the proposed Central Arizona Project—a billion-dollar irrigation system that would transform vast desert areas.

Chester Cambell Chosen President of the Moles

Chester W. Cambell, F. ASCE, president and chief executive officer of The Foundation Company, was elected president of The Moles, an association of leaders in the construction industry, at the organization's annual meeting held in New York on May 3. He succeeds Mansell L. MacLean, M. ASCE, president of MacLean-Grove & Company, Inc.

C. W. Cambell

The other new officers are Harry T. Immerman, F. ASCE, of Spencer, White & Prentis, first vice-president; Eugene G. Rau, F. ASCE, of J. Rich Steers, Inc., second vice-president; Joseph B. Diamond, M. ASCE, treasurer; Eugene F. Moran, Jr., of the Moran Towing Corporation, secretary; and H. Austin Van Name, of the H. A. Van Name Engineering Company, sergeant-at-arms.

During the meeting Frederick H. Zurmuhlen, F. ASCE, commissioner of the New York City Department of Public Works for more than twelve years, was inducted as an honorary member of The Moles. Mr. Zurmuhlen was honored for his "eminent stature as an engineer and administrator of heavy construction work." He is one of two top engineers to be thus honored in the history of the organization. The other was the late Irving V. A. Huie, M. ASCE.

Engineering Index Issues New Edition

A guide to technological literature published all over the world in 1959 will be available this June with issuance of a new edition of the Engineering Index. The 1,600-page reference contains some 30,000 annotations selected from over 1,600 technical publications by a staff of qualified editors who review articles concerning the application of engineering methods and concepts to every phase of the economy.

The information is indexed under 249 divisions of engineering. A complete catalog outlining the coverage of each of these divisions is available free upon request. Subscription is $70, including postage. In addition to the bound volume, the Engineering Index includes a card service on library cards which are mailed each week. This service not only provides prompt information, but also gives the subscriber the privilege of selecting only the divisions in which he is particularly interested.

Inquiries should be sent to the Engineering Index, Inc., 29 West 39th Street, New York 18, N. Y.

April Construction Down From April 1959

The value of new construction put in place in April 1960 amounted to $4.0 billion, according to preliminary estimates of the Bureau of the Census of the U. S. Department of Commerce. This was 8 percent above the March 1960 level, but 6 percent less than in April 1959. The cumulative value of construction expenditures for the first four months of this year amounted to $14.9 billion, 3 percent below the comparable 1959 total.

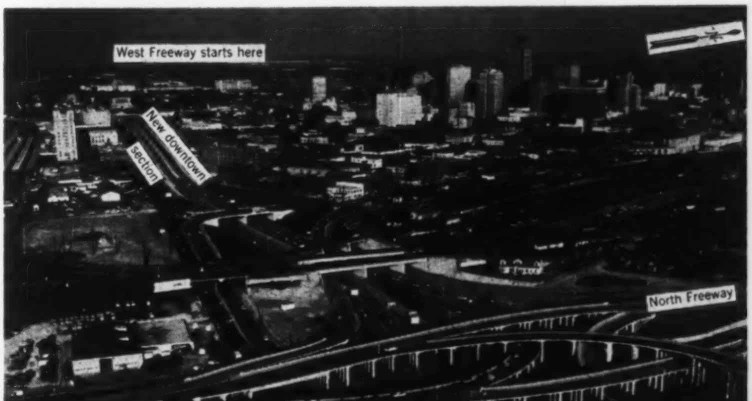
Total new construction expenditures in April 1960 were at a seasonally adjusted annual rate of $52.4 billion, about 2 percent below the March 1960 rate. A slight rise in the seasonally adjusted annual rate of public construction, to $15.3 billion, was more than offset by a decline in the seasonally adjusted annual rate of private construction, to $37.0 billion.

New private construction expenditures in April 1960 amounted to $2.9 billion. This was 4 percent above the March 1960 level but 5 percent less than in April 1959. Spending for private residential building amounted to $1.5 billion in April 1960, 5 percent more than in March, but 15 percent less than for last April. An increase of about 10 percent in private residential expenditures is normal between March and April. The seasonally adjusted annual rate of private construction expenditures, exclusive of spending for residential buildings, was virtually unchanged between March and April 1960. In the first four months of 1960 total new private construction expenditures amounted to $10.9 billion, about 1 percent more than in the comparable period of 1959.

New public construction expenditures this April amounted to $1.2 billion, 20 percent above the March level. The March-to-April change was about normal for the period, with increases in the seasonally adjusted annual rate of expenditures for public nonresidential buildings and military facilities offsetting declines in other categories. The value of public construction in the first four months of 1960 was $4.0 billion, 13 percent less than in the same 1959 period.

Fort Worth Dedicates Cross-City Freeway

With recent dedication of the downtown section of its East-West Freeway, Fort Worth became the first city in Texas to boast a completed freeway from city limit to city limit. It will probably also be the first area in the state to complete its freeway system from county line to county line. Fort Worth has 23 miles of completed freeway; 34 miles under construction; 14 miles planned for early construction; and 82 miles still in the blueprint stage. One of the early projects will carry the East-West Freeway to the Tarrant County line east of Weatherford. Some 40,000 vehicles a day are already using the recently completed freeway—a link in Interstate Highway 20, which will go from Los Angeles to South Carolina. At the ceremonies State Highway Engineer D. C. Greer, F. ASCE, and R. A. Bossy, district engineer, were praised for their work in developing Fort Worth's freeway system.



A New Specification for Carbon Structural Steel

It is expected that Committee A-1 on steel of the American Society for Testing Materials will approve a new specification for 36,000-psi structural steel at its meeting in June. If it does, the ASTM Committee on Administrative Standards can formally certify it for use 30 days later. The new material, designated A36, is compared in the accompanying tables with the well-known A7 and A373 structural steel specifications.

Consideration was given to changing the A7 steel specification. The need of car builders for the ductility associated with a 33,000-psi yield point led to retaining that material and presenting a higher yield point steel as a new ASTM specification, A36.

The following is taken from a paper presented by John R. LeCrow, of the Bethelem Steel Co., before the National Engineering Conference of the American Institute of Steel Construction held in Denver in May.

All ASTM Specifications for Rolled Structural Steel follow a single format which includes a "Scope" clause as Paragraph 1. In this paragraph, the individual steel products which may be supplied are enumerated and the general fields of application are mentioned. Table I shows the differences between the scope clauses of A7, A36 (the proposed specification) and A373.

Table II shows a comparison of the tensile requirements of the three comparable specifications. In general, the tensile strength ranges are closely overlapping, and ductility requirements are almost identical. The proposed new specification has a maximum tensile strength which is 5,000 psi higher than A7 and A373 because of the higher yield point that must be realized.

A major point of interest is the comparison of chemical requirements of Table III. Specification A7 has only a maximum prescribed for phosphorus and sulphur, both residual elements. The identical maxima are a part of A36 and A373, but are omitted so that the carbon, manganese, and silicon requirements can be more easily followed.

Table III shows how closely A36 material approaches A373 material in chemistry and, therefore, weldability. In bars and shapes, the total effect of carbon and manganese is almost identical. In plates the chemistry for the new specification is somewhat higher, particularly in the thicknesses over ¾ in. However, both A36 and A373 offer a much greater guarantee of weldability than does A7. For practical purposes, A36 is virtually synonomous with A373 for shapes and for plates up to ¾ in. and, therefore, equivalent in weldability.

Table I. Comparison of Three Structural Steel Specifications

A7	A36	A373
This specification covers carbon steel plates, shapes and bars of structural quality for use in the construction of bridges and buildings and for general structural purposes.	This specification covers carbon steel plates, shapes and bars of structural quality *not over 4 in. in thickness* for use in the construction of bridges and buildings and for general structural purposes.	This specification covers carbon steel plates, shapes and bars of structural quality *not over 4 in. in thickness* for use in the construction of *welded* bridges and buildings and for general *welded* structural purposes.

Table II. Tensile Requirements Compared

	A7	A36	A373
Tensile strength, psi:			
For shapes of all thicknesses . . .	60,000 to 75,000	60,000 to 80,000	58,000 to 75,000
For plates and bars up to 1½ in., incl. in thickness	60,000 to 72,000		
For plates and bars over 1½ in., in thickness . . .	60,000 to 75,000		
Yield point, min, psi	33,000	36,000	32,000
Elongation in 8 in., min, percent	21	20	21
Elongation in 2 in., min, percent	24	23	24

Table III. Chemical Requirements Compared

		Bars		Shapes		Plates			
A7	C	....		....		....			
	Mn	....		....		....			
	P (max)	0.04		0.04		0.04			
	S (max)	0.05		0.05		0.05			
	Si	....		....		....			
		¾ in. & Under	Over ¾ in. to 4 in.			¾ in. & Under	Over ¾ to 1½ in.	Over 1½ in. to 4 in.	
A36	C (max)	0.28	0.28	0.28		0.28	0.28	0.28	
	Mn	....	0.60/0.90	....		....	0.80/1.10	0.85/1.20	
	Si	....	....	....		....	....	0.15/0.30	
		1 in. and Under	Over 1 in. to 4 in.	Other than heavy W.F.	Heavy W.F. 10-36 in.	½ in & Under	Over ½ in. to 1 in.	Over 1 in. to 2 in.	Over 2in. to 4 in.
A373	C (max)	0.28	0.28	0.28	0.28	0.26	0.25	0.26	0.27
	Mn	....	0.50/0.90	....	0.50/0.90	....	0.50/0.90	0.50/0.90	0.50/0.90
	Si	....	....	....	....	....	....	0.15/0.30	0.15/0.30

AIA Issues Register Of Building Products

The American Institute of Architects has published a "Building Products Register" to provide in one volume, tabular data on comparable products needed for structures. These data give significant characteristics—sizes, colors, strengths, etc.—of several materials grouped together for easy comparison. The Register is impartial and factual; it is planned to supplement rather than to replace product literature. Abstracts of standard documents for different types of products are given immediately following the product listings in each category. Those cited have been furnished by government agencies, testing laboratories, fire underwriters, technical societies and producer associations.

The publication is planned as an annual volume. Periodic supplements and a new-products newsletter are included in the $25 subscription price. A descriptive brochure is available from the Building Products Registry Service, The American Institute of Architects, 1735 New York Avenue Northwest, Washington 6, D. C.

Rapid Transit System Proposed for Los Angeles

Construction of a 43.5-mile rapid-transit system over a five-year period, and the addition of some 110 miles to the network by 1980, has been recommended to the Los Angeles Metropolitan Transit Authority. The program was submitted by the Transit Authority's consulting engineers, Daniel, Mann, Johnson and Mendenhall.

The initial system proposed calls for four routes extending generally northwest, east, south and west from downtown Los Angeles and stretching out to North Hollywood, El Monte, Compton and, West Los Angeles. The full network outlined for construction in the next twenty years would consist of eight routes and serve an area extending from Santa Monica on the west to Covina on the east, and from San Fernando on the north to Long Beach on the south.

Largest Atomic Plant Planned for California

Construction of the nation's largest atomic electric power plant may be started next year by the Southern California Edison Company. Following a recent meeting of the company's Board of Directors, a letter of intent to negotiate contracts for the design and construction of a 360,000-kw atomic power plant has been sent to the Westinghouse Electric Corporation and to the Bechtel Corporation.

The contemplated plant would have the world's largest atomic power reactor. The reactor would be of the closed-cycle water type with a 300-ton reactor vessel. It would be designed and built by Westinghouse who also would supply the steam and electrical equipment. The Bechtel Corporation would be the engineering constructors. The overall plant cost is estimated at approximately $70,000,000. Based on Westinghouse and Edison studies, the plant would be economically competitive with conventional plants over its lifetime. According to present estimates, about four years would be required to construct it. A 360,000-kw plant supplies enough electricity for a city of half a million.

The actual start of construction will depend on the completion of contracts, approval of the Atomic Energy Commission and the California Public Utilities Commission, and selection of a specific site.

Code Conference Explores High Building Costs

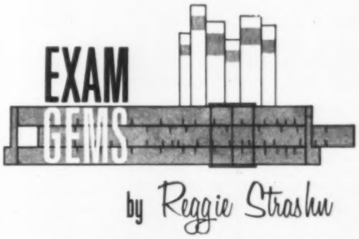
Building codes were discussed in relation to high building costs at a recent all-day conference held in Washington, D.C. About 100 representatives of building code work in all parts of the United States assembled for the Code Conference at the invitation of the National Association of Home Builders to meet the challenge of the sixties with the many new materials to be recognized.

In a review of the code situation J. S. Norman, Jr., chairman of the NAHB Code Committee and conference chairman, said that the basic problems confronting the building industry are excessive requirements, antiquated codes, and too many codes. He emphasized that correction must not be left to the general public, to town or government officials, or to model building code groups, but that it should be undertaken by the housing industry.

However, the conference brought out that it is not the poor or antiquated codes that are primarily responsible for high building costs, but rather the restrictive practices of the mechanical trades hidden in the codes. This point was made by William B. Tabler, chairman of the American Institute of Architects' Building Code Committee. In outlining the various conflicting code requirements in different sections of the country, Mr. Taber noted, in particular, the restrictions in plumbing and electrical work. He also noted that exit requirements are sometimes impossible of interpretation to meet conditions realistically. He said the restrictive practices of trades hide behind building codes and cited the plumbing and electrical trades as cases in point. Mr. Tabler urged the adoption of national standards without regard to restrictive labor practices, and the establishment of local appeal boards for review of new products and processes.

In closing the meeting, the National Association of Home Builders offered to act as a clearing house, through its local sections throughout the country, to work for adoption of proper codes.

ASCE was represented at the conference by Bernard F. Locraft, F. ASCE, Washington civil engineer.



R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 11 inspired this pathetic response from Mr. Slowe, "Relative to unit movement of Block B to the left, Block A moves two units down its slope and 3 units down the wall. Hence the work. . . . TIME!!!!"

This looked like a desperate but futile bluff that Slowe knew all about friction and could have scored if the ding-danged bell hadn't ding danged. Before awarding him an F for *fraud* instead of an E for *effort,* let's look over two other shoulders. Mr. Sharpe letter-symboled his sketch (Fig. 1) and wrote:

$H=P+fV=N\sin\phi-fN\cos\phi$ (1) (2)

$V=F-fH=N\cos\phi+fN\sin\phi$ (3) (4)

from statics of both blocks together and then Block B alone. P, f and ϕ being given, he had four equations in F, H, N and V, from which he deduced:

$F\,[(1-f^2)\tan\phi-2f]=P(1-f^2+2f\tan\phi)$ . . . . (5)

Upon substituting $P=100$, $f=0.25$ and $\phi=60°$, he found

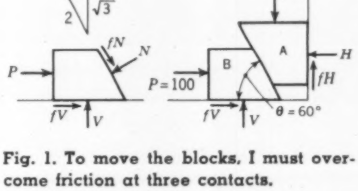


Fig. 1. To move the blocks, I must overcome friction at three contacts.

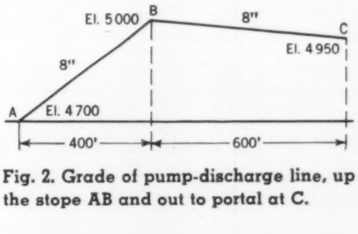


Fig. 2. Grade of pump-discharge line, up the stope AB and out to portal at C.

$$F(0.9375\sqrt{3}-0.5=100(0.9375+0.5\sqrt{3})$$
$$1.1238\,F=180.35$$
$$F=160.5\text{ lb}$$

Making it so easy, Sharpe was either bright or he guessed right. The second shoulder was Mr. Swift's, who guessed wrong. Thinking too swiftly, he directed fV to the left, opposing P. Others guessed wrong on fN for just one reason—they wouldn't take time to think. Remember, *friction opposes motion,* not force. Block B being pushed to the left is resisted by friction acting to the right.

Now let's look critically at Slowe's epilogue. His last word "work" and the relative movement of the blocks implied a plan to work the problem with a work equation, that is, input energy equals output work. Work being force times distance and the relative distances being 1, 2 and $\sqrt{3}$,

$F\sqrt{3}=P+fV+fH\sqrt{3}+2fN$ (6)

Maybe Slowe knew the interesting fact that friction on the interface matches the friction on the two outer faces, that is, that

$2fN=fV+fH\sqrt{3}$ . . . . (7)

Substitute this in (6) and recalling (1) and (3),

$F\sqrt{3}=P+2fV+2fH\sqrt{3}$ . . . . . (8)

$H=P+fV$ . . . . (1)

$V=F-fH$ . . . . (3)

Slowe could have found F from these three equations in F, H and V. In fact, a solution by the work method is the least work and, whether or not he knew where he was going, Slowe was on the right track.

Hence two elements made this problem a gem: (1) the importance of careful thinking about the direction of frictional forces and (2) the reward to those who could work with work to have the least work.

EXAMGEM No. 12

With the Society meeting at Reno this month, this is an appropriate time to resurrect a 20-yr-old Nevada problem reminiscent of the flooded mines of the Comstock Lode. Finding an extra 100 ft of pipe along the stope lulled the unwary to overlook other ways to go wrong. It read:

An electric pump with 80 percent efficiency must remove 900 gpm of mine seepage from a sump at A (see sketch, Fig. 2). Discharge line ABC is an 8-in. steel pipe with Kutter's $n=0.013$. Required: the power of the motor in kw.

DECEASED

Oliver Ames (M. '39; F. '59), age 63, for nearly 32 years field project manager at many of the E. I. du Pont de Nemours & Company, Inc., plants, died in Wilmington, Del., on April 23. An executive in the design division of Du Pont, during World War II he was manager in charge of all commercial construction. After the war he was sent to Japan by the United States government to study the effects of bombing on the chemical and oil industries in Hiroshima and Nagasaki.

John M. Belknap (M. '08; F. '59), age 88, a practicing engineer from 1896 until his retirement in 1948, died recently in Ashtabula, Ohio. In his early career, Mr. Belknap was connected with several important railroad companies, including the New York Central & Hudson River Railroad, which he served as assistant engineer of buildings and as engineer on the Grand Central Terminal Improvements in New York. Later, as resident engineer with the Terry & Tench Company and the Tench Construction Company, he had charge of the location and construction of the Bear Mountain Bridge over the Hudson, at that time the longest suspension bridge in the world. From 1934 until his retirement, he was in the United States Engineer Offices at Zanesville, Ohio and Huntington, W. Va.

Finn Olafsson Berge (M. '51; F. '59), age 55, for 24 years (1926-1950) an engineer in Shanghai, China, died recently in Porsgrunn, Norway. Mr. Berge's work in China included eight years as structural engineer with the Public Works Department. More recently, he had served as consulting civil engineer in the Norwegian firm, Aarum & Berge.

Horace A. Bestor (A.M. '26; M. '59), age 75, who made a lifetime study of land use and its related water problems, died recently in Clewiston, Fla. His study in 1926 for the U. S. District Engineer on the Caloosahatchee river and Lake Okeechobee drainage areas became the basis of federal appropriations for the project now embraced in the Central and Southern Florida Flood Control District. This initial interest in the reclamation and water control programs of the area was augmented during 16 years in the employ of the Southern Sugar Company, and the present U. S. Sugar Corporation, where he had responsibility for the planning and organization of the various reclamation districts bordering Lake Okeechobee and by 14 years of consulting work on land development projects in the region.

Henry B. Cooley (A.M. '30; M. '59), age 61, since 1954 professor and head of the Department of Management and Finance in the School of Business at Florida State University, Tallahassee, died there recently. For four years Professor Cooley was assistant city engineer of New Orleans. He also had been resident engineer with the Louisiana Highway Commission. In 1937 he became assistant professor of economics and business administration at West Virginia University.

Robert B. Brooks, Former ASCE Officer, Dies

Robert B. Brooks (M. '24; F. '59), age 71, former ASCE officer, internationally known consulting engineer, and former St. Louis director of streets and sewers, died in St. Louis, Mo., on April 30. Mr. Brooks, who often represented the United States in highway, sanitation, and municipal problems, was a United States representative to Mexico City at the 1936 dedication of the Pan-American Highway—which he had helped to institute. He also had a hand in planning the 2,000-mile Mississippi River Parkway from Canada to the Gulf of Mexico, and in 1956 was honored with the distinguished service award of the Mississippi River Parkway Planning Commission. He served ASCE as Director from 1939 to 1941 and as Vice President from 1949 to 1950.

William Russell Davis (M. '31; F. '59), age 90, retired civil engineer, whose most significant accomplishment was the design of the $5 million International Peace Bridge at Buffalo, N. Y., died recently in Los Angeles, Calif. In private consulting practice for much of his professional life, Mr. Davis was chief bridge designer and inspector in the office of the New York State Engineer for over ten years before entering private practice.

Elliott J. Dent (M. '15; F. '59), age 82, Colonel, U. S. Army (Retired), of Washington, D. C., died there recently. A graduate of the U. S. Military Academy at West Point, Colonel Dent early in his army career served as a Lieutenant with engineer troops in the Philippine Islands and later as a Colonel with the Corps of Engineers in Washington, D. C. He was a specialist in beach erosion. After retiring from the Corps in the 1930's. Col. Dent remained in Washington where he had a consulting engineering practice.

Mortimer L. Diver (A.M. '21; M. '59), age 73, consulting engineer of San Antonio, Tex., died there recently. A specialist in reinforced concrete design, Mr. Diver had maintained a general consulting practice since 1921. He had practiced in San Antonio since 1933.

John W. Emig (M. '09; F. '59), age 84, from 1932 until 1959 engineer-contractor with the B. W. Construction Company, of Chicago, died recently in Evanston, Ill. Engineer-designer of theatres, plants and all types of buildings throughout the United States, Mr. Emig was engineer on many of the buildings for Chicago's Century of Progress Exposition.

John M. Evans (M. '37; F. '59), age 67, a long-time member of the engineering staff of the Standard Oil Company of California, died recently in Oakland, Calif. Mr. Evans joined Standard Oil in 1915 after receiving his B.S. in civil engineering from the University of California. Since then he had served the firm as head of the civil engineering division, as vice-president and director, and as chief engineer and chairman of the board of engineers.

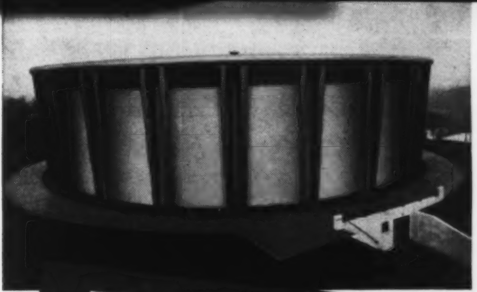
Francis Duncan Finlayson (M. '44; F. '59), age 63, vice-president and chief engineer of the Westcott Engineering Company, Chicago, Ill., died recently in Park Ridge, Ill. Mr. Finlayson had been vice-president and chief engineer of the firm since 1951, having previously (1920-1933) served it as structural designer. During the intervening years he was structural and chief structural engineer with another Chicago firm, Montgomery Ward & Company.

Leroy Burrows Fugitt (A.M. '21; M. '59), age 73, secretary-treasurer of the Southern Construction Company, Oklahoma City, Okla., died there recently. Prior to becoming secretary-treasurer in 1956, he had served the firm for nearly ten years as president. At different times before joining Southern Construction he had engaged in consulting engineering work in Chicago, Louisville, and Hoisington (Kans.)

Robert L. Gay (A.M. '42; M. '59), age 54, specialist in plant and bridge construction, died recently in Baton Rouge, La. At the time of his death, Mr. Gay had been senior bridge detailer with the Louisiana Department of Highways for thirteen years. Earlier he served as assistant resident engineer for Ira G. Hedrick, Inc., on a reinforced concrete arch bridge over the Red River and as engineer and employment manager of Siems-Helmers, Inc., on construction of the $11 million bridge over the Mississippi River at New Orleans.

James R. Hardesty (M. '51; F. '59), age 79, whose work as a consulting engineer and architect ranged from bridges to monuments, died recently in Chevy Chase, Md. During a career which lasted 36 years, many of them with the Government, Mr. Hardesty had contributed

(Continued on page 120)



A striking example of fine appearance and exacting craftsmanship is this PDM Steel Reservoir built for the Municipal Authority of the Borough of West View, Pa., in a high-value residential district. An entire hilltop was removed to make room for the 5,000,000 gallon structure, special architectural detailing employed for visual appeal, and a two-tone blue color scheme applied to complete a most unusual and applauded neighborhood feature. • Do you have a particular water storage problem? Let us discuss it with you!

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SEATTLE (1)	500 Wall Street

Deceased

(Continued from page 118)

to construction of the Ft. Knox (Ky.) gold depository, the silver depository at West Point, N. Y., a jet turbine laboratory at Trenton, N. J., traffic control centers for the Federal Aviation Agency, and the design of security buildings and housing for the Antarctic "Operation Deep Freeze." His design of the principal chapel at Fort Belvoir (Va.) called for the unusual feature of a prefabricated steeple.

Harry C. Hess (M. '28; F. '59), age 70, in private engineering practice in Philadelphia, Pa., since 1918, died there on April 6. He was a graduate of Baltimore Polytechnic Institute. Mr. Hess' early work included experience as structural designer for the General Electric Company, Pittsfield, Mass., on the design of steel and concrete plant buildings, and as manager of the Wilkes-Barre office of the Scranton Iron and Steel Company.

Charles St. Barbe Kindersley (A.M. '49; M. '59), age 38, assistant engineer with Sir Alexander Gibb & Partners, London, England, died recently. In 1943, the year of his graduation from Cambridge University, Mr. Kindersley joined Sir Alexander Gibb as a junior engineer and since then had done extensive work for the firm on a hydroelectric and irrigation project in Persia.

Charles Mannel (M. '38; F. '59), age 72, retired civil engineer of Asheville, N. C., died there recently. Before establishing his consulting practice, Mr. Mannel had engaged in hydraulic and hydroelectric work with the late Charles A. Waddell, the Morrison-Knudson Company, and Six Associates. He retired in 1958.

Eugene L. Meyer (J.M. '50; A.M. '59), age 32, junior civil engineer with the California Division of Highways at Wabash, Calif., died recently in Eureka, Calif. A 1950 civil engineering graduate of Stanford University, Mr. Meyer had joined the Division of Highways in 1951.

Paul D. Miesenhelder (M. '35; F. '59), age 63, for the past ten years concrete engineer on the Research Staff of the Association of American Railroads, Chicago, Ill., died there recently. Mr. Miesenhelder's previous experience was as a research assistant in the Engineering Experiment Station at Purdue University, and as assistant engineer, testing engineer, and assistant chief engineer in charge of the Materials Department of the Indiana State Highway Commission.

Henry S. Miller (M. '42; F. '59), age 63, since 1957 director of the St. Louis (Mo.) Department of Streets, died in St. Louis recently. A city employee for 34 years, he had, until his recent appointment, served successively as engineer on the design of sewers and streets and as assistant chief engineer of the Division of Sewers and Paving.

Hobart M. Mumaugh (M. '44; F. '59), age 63, for the major part of his professional life in the employ of the Ohio Highway Department, died recently in Lima, Ohio. Mr. Mumaugh, who first joined the Department in 1921 as assistant engineer, was named assistant division engineer in 1939 and county engineer in 1941.

William E. Mutterer (A.M. '47; M. '59), age 48, employed by the Mahony-Troast Construction Company for approximately 14 years as building construction estimator, died recently in Passaic, N. J. A civil engineering graduate of the Newark College of Engineering, he had also been an instructor in building construction estimating at his alma mater.

Harold D. Noteware (A.M. '26; M. '59), age 66, a consulting civil engineer and specialist in irrigation and reclamation, died recently in Stockton, Calif. Over a period of 34 years Mr. Noteware had played a major part in reclaiming and developing the Sacramento River Island properties as consulting civil engineer, engineer and manager of the California Subdivision Company.

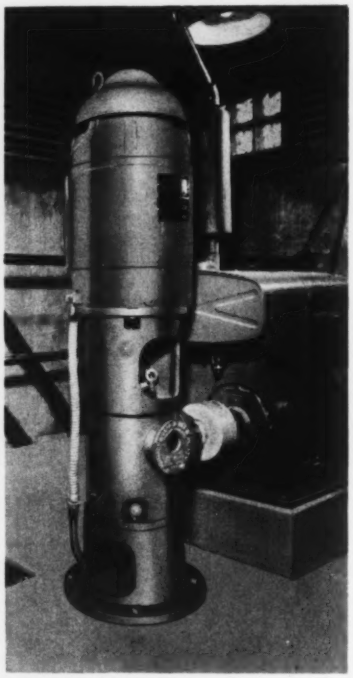
Samuel Wyatt Pinkston (A.M. '55; M. '59), age 37, construction engineer with Harold L. Smith & Associates, Stuttgart, Ark., died there recently. His previous experience included five years as topographic engineer with the U.S. Geological Survey and a few years as construction engineer with the Houston (Tex.) firm, Farnsworth & Chambers Company, Inc.

Harold L. Reichel (A.M. '46; M. '59), age 52, since 1949 manager of logging and forest operations for the Weyerhaeuser Company at its Vail-McDonald Operations, Chehalis, Wash., died there on April 18. Mr. Reichel had been employed by the Weyerhaeuser Company and its subsidiaries since 1928.

Robert E. Robertson (M. '23; F. '59), age 76, long-time Cerro Gordo County (Iowa) engineer, died recently in Mason City, Iowa. Mr. Robertson was considered a pioneer in the development of the Iowa road system. When he assumed the position of county engineer in 1914, the county had only one mile of surfaced road. His retirement in 1954 ended 40 years of service.

Floyd M. Roush (M. '55; F. '59), age 63, regional irrigation supervisor for the Bureau of Reclamation, Denver, Colo., died there recently. After serving in the Wyoming state engineer's office from 1929 to 1936 and as Wyoming state en-

(Continued on page 122)



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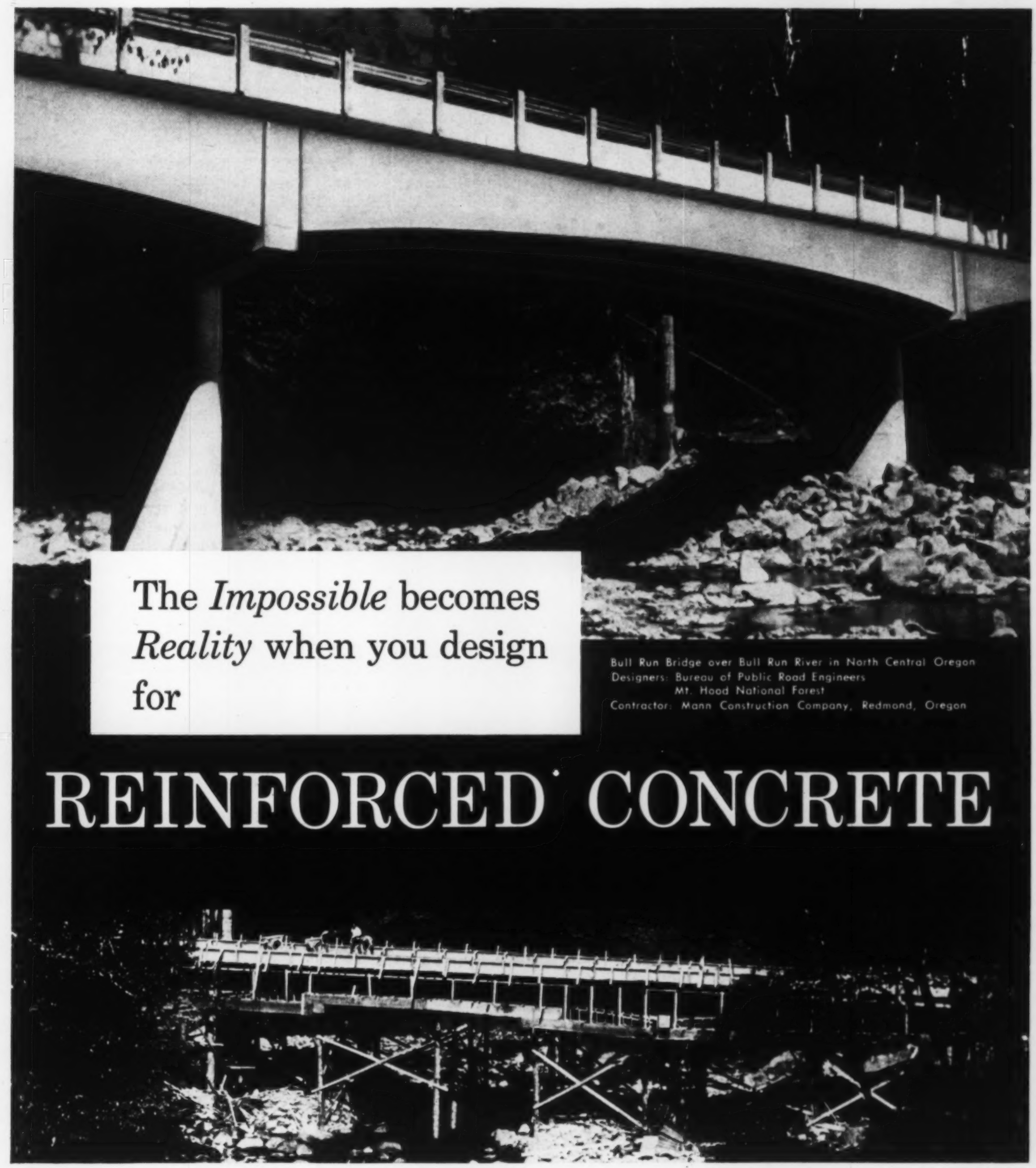

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(Continued from page 120)

gineer in 1936 and 1937, Mr. Roush joined the Bureau of Reclamation. He was promoted to his last job in November 1959.

Charles Schultz (M. '20; F. '59), age 79, former city engineer of Hannibal, Mo., McKinney, Tex., and Tulsa, Okla., died recently in Richmond, Tex. In private practice since 1928, Mr. Schultz had served as city, county, and state contractor in addition to maintaining an office in Foster, Tex., from 1940 to 1950, and in Richmond from 1950 until his death.

William B. Settoon (A.M. '58; M. '59), age 47, for the past seven years head of the structural department of Curtis & Davis and Associated Architects and Engineers, New Orleans, La., died there on March 27. Mr. Settoon, who had recently been made an associate of the firm, previously served as an engineering designer with Geo. P. Rice. In the latter position, he designed water distribution systems for the New Orleans Port of Embarkation, the Air Mechanics School at Gulfport, Miss., and the Air Support Command Base at Pollock, La.

William G. Sloan (M. '08; F. '59), age 84, a former New Jersey state highway engineer, died in Princeton, N. J., on April 22. Mr. Sloan's engineering experience embraced the construction of highways, railways, bridges, tunnels, steamship docks and large manufacturing plants. As chairman of three advisory boards, Mr. Sloan played a role in the development of such important projects as the Pulaski Skyway, the New Jersey approaches to the Hudson River vehicular tunnels and the George Washington Bridge, and the Jersey City-Kearney Bridge over the Hackensack River.

James Hampden Small (M. '19; F. '59), age 40, for more than 25 years president of the James H. Small Company, died recently in Jacksonville, Fla. Before establishing his own firm, Mr. Small was president and general manager for eleven years of the American Construction Company in Cleveland, Ohio.

Harry Sprague (A.M. '53; M. '59), age 43, director of the Design Division of Public Works, U. S. Navy District, Kodiak, Alaska, died recently. Before taking over as director of the Design Division, Mr. Sprague was head of the structural and architectural design section of the U. S. Bureau of Reclamation at Ephrata, Wash.

Samuel F. Tapman (A.M. '22; M. '59), age 71, retired civil engineer of Jacksonville Beach, Fla., died there recently. Mr. Tapman was a former president of the New York City firm, the William W. Beers Company, where he designed and marketed standardized steel structures. Earlier he was chief engineer of Hamilton and Chambers Company, Inc.

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3. Adhesive with THIOKOL liquid polymer—made and sold commercially by several processors—is spread on prepared surface with brooms or heavy brushes. Thirty minutes later, while adhesive is still tacky, new concrete is poured.

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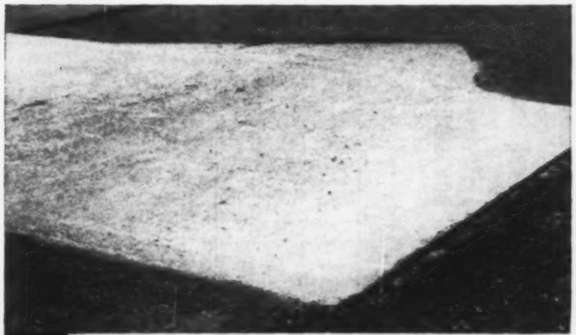

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New in education

Portland engineers offered a four-year masters at night . . . .

Civil engineers in the Portland area who desire to work toward an M.S. will be interested to learn of a new graduate program recently adopted by *Oregon State College* and the *Portland Extension Center*. Under the new arrangement, night classes in graduate engineering will be offered by the PEC beginning this fall, and credits for these courses will be accepted by the OSC School of Engineering, which will grant the Master's degree. No resident study at the Corvallis campus will be required for any of the courses. It will require approximately four years through the new system to fulfill the entire requirements for the degree. Interested engineers should write to the Portland Extension Center, 1633 S.W. Park, Portland, Ore.

Instruction in the basics of bio-oxidation of organic wastes . . . .

The fundamentals of bio-oxidation as a framework for the analysis, design, and operation of biological waste treatment facilities is being offered by the *Civil Engineering Department of Manhattan College*, June 20-24, under "The Fifth Course on Bio-Oxidation of Organic Wastes Theory and Design." The $100 fee for the course includes a set of notes and the mixer. All correspondence should be addressed to Prof. W. Wesley Eckenfelder, Civil Engineering Department, Manhattan College, New York 71, N. Y.

Wide variety of courses available this summer . . . .

A one-week summer study course in thin-shell concrete structures will be offered at the *Case Institute of Technology*, Cleveland, Ohio, July 18-22. Designed for engineers and architects who would like to know more about the theory and design of the new and dramatic structures currently being built, the course includes the analysis and design of domes, hyperbolic paraboloids, cylindrical shells and folded plates. Tuition for the program is $200. Requests for applications may be addressed to Dr. James R. Hooper, Jr., Director of Special Programs. All other inquiries should be addressed to Dr. John B. Scalzi, Associate Professor of Structural Engineering, Case Institute of Technology, University Circle, Cleveland 6, Ohio.

Intensive courses covering 21 subjects will be offered this summer to practicing engineers and scientists by the *University of Michigan College of Engineering*. Courses range from automatic control to technical writing—including "Human Engineering Concepts and Theory," will be one or two weeks in length and will run from June 13 to August 15. Among the 75 to 80 visiting lecturers will be such highly-regarded engineers and scientists as James H. Wilkinson of the National Physical Laboratories of England, Fredrich L. Bauer of the University of Mainz, Germany; and Alston S. Householder of the Oak Ridge National Laboratory. For information contact Chuck Wixom, University of Michigan, Administration Building, Ann Arbor, Mich.

Ten engineering seminars, to be conducted by the *Pennsylvania State University College of Engineering and Architecture* and Continuing Education Services, are scheduled for this summer. Of special interest to civil engineers are: Atomic Shelter (architectural and engineering planning aspects), July 10-22; Research and Development Management Development, July 24-29; Atomic Shelter (structural engineering and radiation shielding aspects), July 24-August 5; Work Measurement, August 28-September 2; and Technical Report Writing, September 19-30. A descriptive brochure may be obtained from the Continuing Education Conference Center, Pennsylvania State University, University Park, Pa.

Principal focus of a special summer program at the *Massachusetts Institute of Technology*, June 20 to June 24, will be the similarities and differences between plastics and glass with respect to strength and fracture behavior. Tuition for the morning and afternoon sessions is $200. Requests for information should be addressed to John I. Mattill, Associate Director, Massachusetts Institute of Technology, Cambridge 39, Mass.

Course in water bacteriology . . . . .

A one-week course on recent developments in water bacteriology will be presented August 15 through 19—and, again January 23 through 27—by the training program of the *Robert A. Taft Sanitary Engineering Center*, Cincinnati, Ohio, major research and engineering laboratory of the Public Health Service. The course is offered for professional bacteriologists and those in positions of responsibility in bacterial water analyses. Applications should be addressed to the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio, or to a PHS Regional Office Director.

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Unusual underpinning supports operating subway while new track is built beneath. Plan entails no interior shoring of existing subway, no track-shifting or changes in electric system or signals, permitting normal service during construction.

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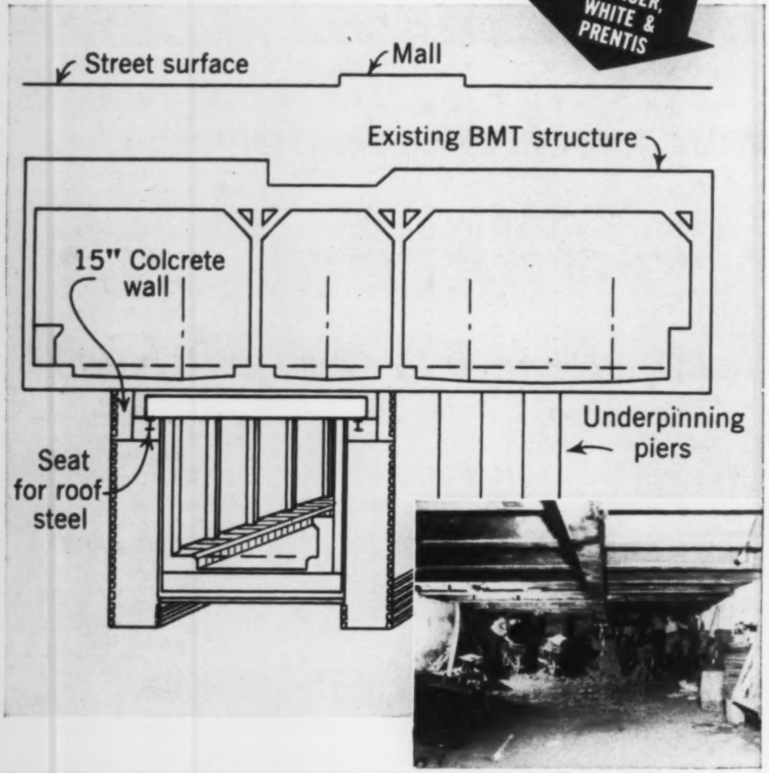

Project: **Chrystie Street Subway, Section 2, Route 112, for New York City Transit Authority**
General Contractor: **Cayuga Construction Corp., New York City**

With headroom of 5 in. or less between the top of the new steel and the bottom of the operating subway, the use of temporary needle beams as a shoring method on this job posed a problem.

Solution: this unusual plan. The new line's permanent steel roof beams (increased in size and length) were incorporated into the underpinning system, carrying the load temporarily to the retaining walls and later to the completed new foundation.

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News of Members

(Continued from page 28)

Charles E. Weinkauf will supervise the personnel and functions of the engineering section in the Distribution Department of the Manufacturers Light and Heat Company, Pittsburgh, Pa., in his new capacity as distribution engineer. Mr. Weinkauf has been assistant distribution engineer since 1954.

Kenneth J. Boedecker, who joined the Reynolds Metals Company in 1954 as an industrial engineer at the Harrison, N. J., plant, has been appointed to the newly-created position of manager of the aluminum structures market. For the past two years he has been assistant to the general manager of the sheet division.

Organizational Changes At Portland Cement Association

► The Rocky Mountain Region of the Portland Cement Association with headquarters in Denver, has been strengthened through the addition of **Edward W. Thorson** as full-time regional manager and the establishment of a new district office in Albuquerque, to improve service in the state of New Mexico. Mr. Thorson has been with the Association since 1934.

◄ Succeeding Mr. Thorson as district engineer for Colorado and Wyoming is **Jack Y. Barnes.** Mr. Barnes joined the Association in 1937, serving with the Des Moines district before becoming district engineer at Helena in 1952.

► **Bernard C. Smith,** for the past seven years general field engineer for New Mexico, is now district engineer for New Mexico, with offices at Albuquerque. Mr. Smith joined the Association in 1953.

◄ **Thomas D. Shiels,** for the past five years district engineer for the Austin, Tex., office of the Portland Cement Association, has been named South Central regional manager. He has been with the Association since 1925, which he joined as field engineer in the Dallas District Office.

RECENT BOOKS

(added to the Engineering Societies Library)

Application de la Geologie aux Travaux de L'Ingenieur

Intended for the consulting geologist and for the engineer faced with geologic problems in construction engineering. Methods of terrain and subterranean exploration and documentation, including geophysics, boring and tunelling are presented. Rocks above and below ground, their properties as natural formations and as building materials, and subterranean hydrology are studied. The final section deals with protective measures against earthquake, landslide, erosion, and heavy snow and wind. (By Jean Goguel. Masson & Compagnie, Paris, France, 1959. 357 pp., paper.)

Bituminous Paving Materials

This volume combines the papers presented at two symposia, one on the methods of test for design of bituminous paving mixtures, and the other on the practical and statistical significance of tests and properties of bituminous binders, presented at the technical session on road and paving materials. (Published as ASTM Special Technical Publication No. 252 by the American Society For Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1959. 232 pp., bound. $5.50.)

Curve Surveying

This handbook deals with methods of setting out circular arcs with chain, tape and theodolite, the location of compound and reverse curves, the amount of cant required, the cubic parabola, the clothoid and lemniscate. Also discussed are the maximum safe speed for a vehicle on a circular arc, the best length for a transition curve, the forces at the treads and flanges of railway wheels, and the Hallade method for aligning railway curves. (By R. B. M. Jenkins. Cleaver-Hume Press Ltd., London, England, 1960. 184 pp., bound. £ 1.15.0.)

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Engineering Economy

Third Edition

All commonly used economy study methods here are analysed in terms of their background, principles and procedures, together with discussion of the frequent importance of non-monetary factors in economic decisions. This edition is almost completely rewritten. (By E. Paul de Garmo. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1960. 580 pp., bound. $8.75.)

Highway Engineering

Second Edition

The purpose of this book is to give an integrated picture of the whole field of highway engineering, presenting the material in the order in which it commonly would occur in the development of a highway or highway system. Administration, economics, financing, and planning are dealt with at length, followed by chapters on design, construction and maintenance, which stress fundamental principles. This new edition incorporates the major advances in the field, and shows the effect of the Federal Highway Act of 1956. (By Leo J. Ritter, Jr. and Radnor J. Paquette. The Ronald Press Company, 15 East 26th Street, New York 10, N. Y., 1960. 751 pp., bound. $10.00.)

Non-ASCE Meetings

American Institute of Electrical Engineers. Pacific general meeting at the El Cortez Hotel, San Diego, Calif., August 8-21.

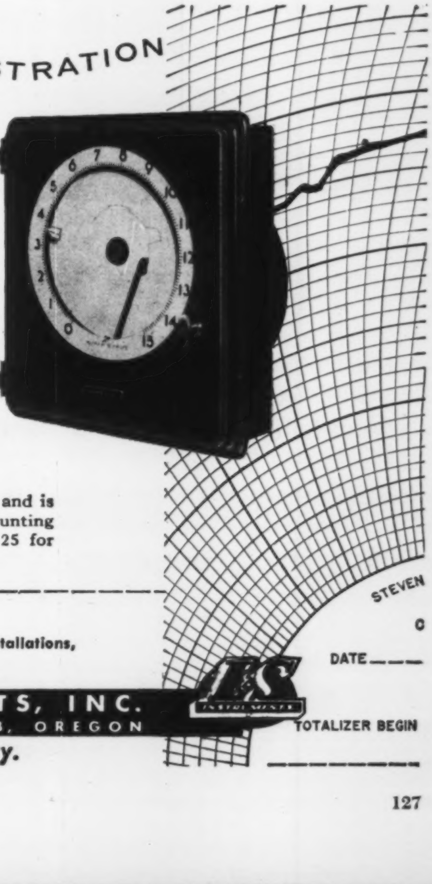
American Society of Landscape Architects. Sixty-first annual meeting at the Waldorf-Astoria, New York, N.Y., June 26-29.

American Society for Testing Materials. Annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N.J., June 26-July 1.

Cooper Union. Conference on civil engineering education co-sponsored by the American Society of Civil Engineers and the American Society for Engineering Education at the University of Michigan, Ann Arbor, Mich., July 6-8.

International Association for Bridge and Structural Engineering. Sixth congress in Stockholm, Sweden, June 27-July 1.

Israel Institute of Technology. International symposium on concrete and reinforced concrete in hot countries at the Building Research Station of the University, Haifa, Israel, in July.



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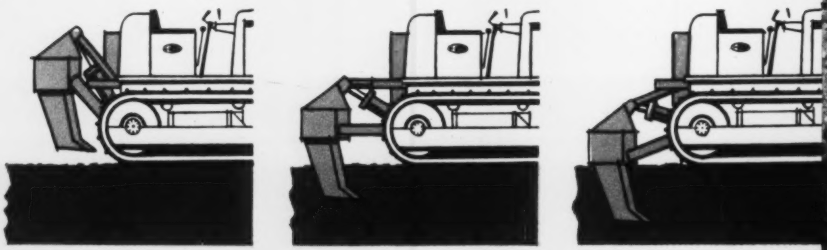

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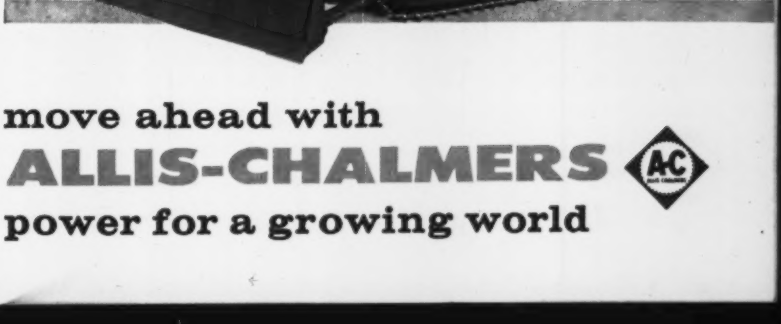

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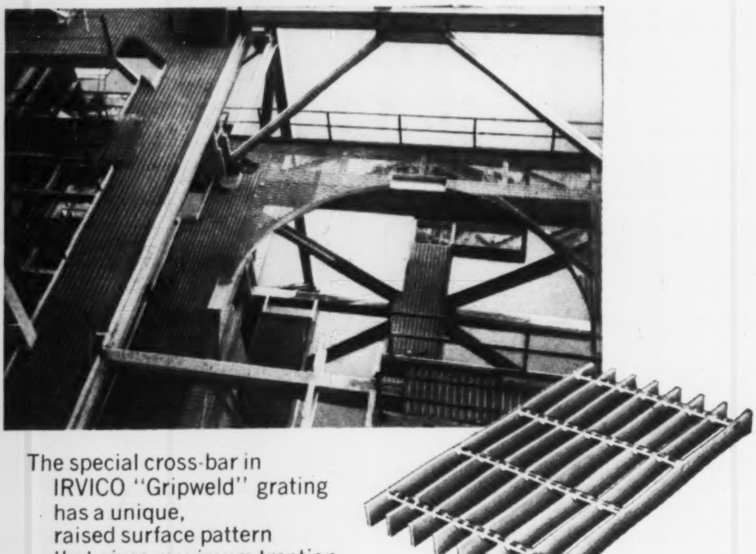

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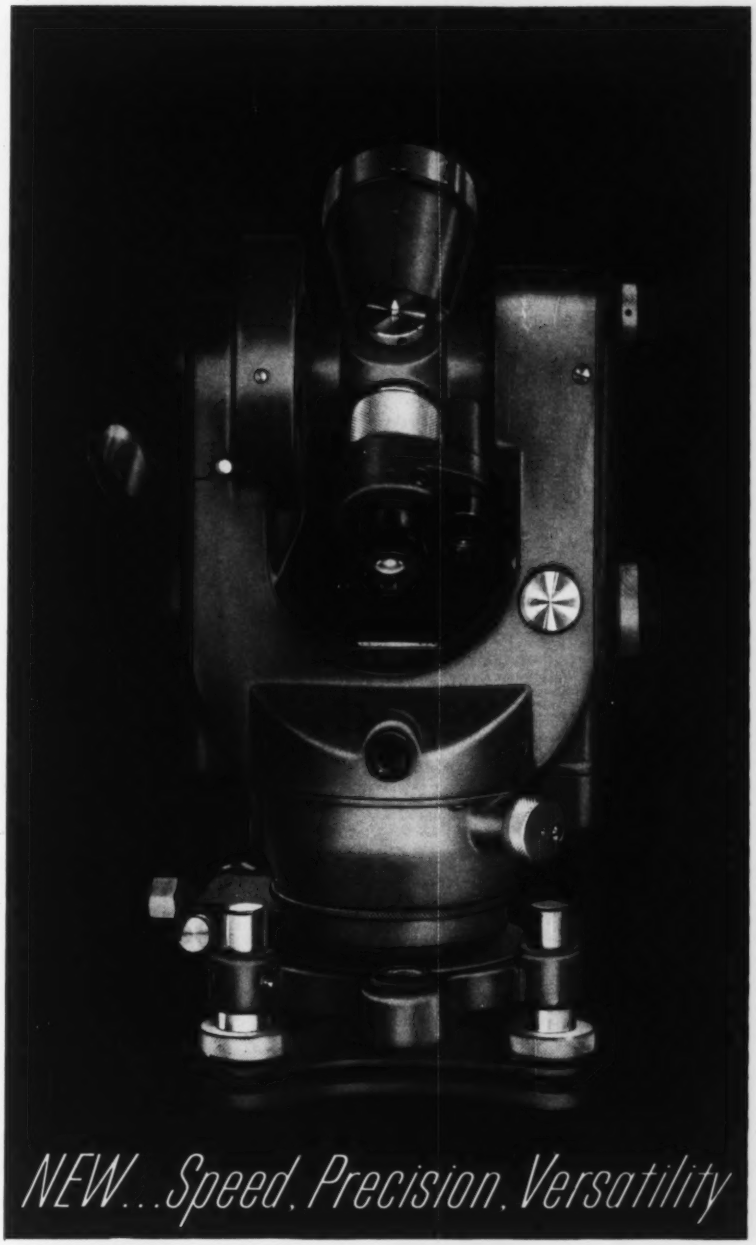

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Civil Engineer, F. ASCE, B.S.C.E., Over 25 years of general field and office experience on large water supply projects, including dams, reservoirs, tunnels, highways, sewers, public utilities and real estate condemnation, of which 20 years have been in a supervisory capacity. C-561.

Civil Engineer, A.M. ASCE, B.S.C.E. Presently assistant resident on flood control projects, including dams, levees, conduits, and reinforced concrete structures. Desires position with opportunity for professional advancement with consultant or association. Location desired, Philadelphia, Pa. area. C-562.

Civil Engineer, M. ASCE, B.C.E., Registered in New York. Experience includes 18 years on water supply, sewage disposal, utilities design, estimates, specifications, construction. Location desired, Metropolitan Washington, D. C. C-563.

Civil Engineer or Instructor, A.M. ASCE, M.S. Structural engineering with some experience in highway and ten years of experience in teaching applied mechanics, surveying, mathematics and phyiscs. Location desired, East or Midwest. C-564.

Construction Manager, A.M. ASCE, Registered C.E. in Maryland. Twenty-three years of experience in design, layout, estimating and supervision of construction of schools, office buildings, warehouses, truck terminals, bridges and water treatment plants. Location desired, Southeast. C-565.

Office Engineer, A.M. ASCE. Job desired by licensed civil engineer with six years' experience in Government and commercial building construction, also experience as laboratory supervisor for testing laboratory. Excellent in coordinating all phases of design and construction. Location desired, Houston, Tex. area. C-545.

Engineer, F. ASCE, B. S. Thirty years' engineering dams, marine works, industrial facilities, airfields, cities. Location desired, South, Southwest or Far West. C-546.

Supervising Civil Engineer, M. ASCE, B.S. and M.S. in C.E., P.E. in New York, New Jersey, Delaware and Pennsylvania. For 12 years in responsible charge of design and construction of chemical and industrial plants, bridges and port structures. Location desired, Northeast. C-547.

Geodetic and Photogrammetric Civil Engineer, M. ASCE, CE degree. Experienced in geodetic and photogrammetric surveying, subdivision and industrial site planning and route surveying. C-548.

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Civil Engineer, A.M. ASCE, B.S.C.E., Licensed P.E., structural and hydraulic. One year's experience as project engineer and two years' experience as office engineer. Experienced in surveying, irrigation, hydrology, hydraulics and structural design. Location desired, New England area. C-550.

Civil Engineer, M. ASCE, B.C.E. and M.S., P.E. and L.S. New York, 35. Twelve years' experience on the design and supervision of construction; soils, pavements, foundations, site planning, surveys, drainage, sewage; reports, estimates, specifications. Responsible positions. Location desired, New York, Westchester and vicinity. C-551.

Municipal Engineer or Engineering Management, M. ASCE, C.E., P.E. Virginia. Over 20 years of diversified experience in public works planning, engineering, design and construction, including selection and administration of A-E and construction contracts. C-552.

Soils Engineer, A.M. ASCE, C.E., SM, 28. Experienced in soil laboratory, reports, design of earth dam. Interested in any kind of job related with soil mechanics and foundation engineering. Speak Spanish. Location desired, U.S.A. C-553.

Construction Engineer, A.M. ASCE, B.S.C.E., registered E.I.T., 26. Six months on highway design and construction, and three and a half years as a construction engineer for the Air Force doing field layout of roads, buildings and utilities and supervising the work. Also served as project engineer on a 400 unit housing project for the A.F. Location desired, Indianapolis, Ind. and vicinity. C-1086-Chicago.

Chief Engineer or Management, M. ASCE, M.S.C.E., 43. Three years as chief engineer, with responsibility for training graduate engineers for middle management in concrete technology, process, plant, structural. Seven years as structural consultant with architects, engineers and contractors. Am capable speaker and writer. Former college professor. C-1083-Chicago.

Civil Engineer, A.M. ASCE, B.S.C.E., Registered professional engineer in Texas, Oklahoma, Louisiana, Registered Public Surveyor in Texas, 32. Ten years as civil with major oil company. Location desired, Southwest. C-1078-Chicago.

Junior Consulting or Construction Engineer, A.M. ASCE, M.S.C.E., E.I.T. Mississippi 23. Graduated upper 5% of class (emphasis on structures during academic training). Three years military obligation to be completed August, 1960. Location desired, South and Foreign. C-1091-Chicago.

Project or City Engineer, M. ASCE, B.S., M.S., P.E. license in Ohio and Indiana, 41. Fifteen years of broad office experience. Capable of completing highway road design, including interchanges, and sewer design. Other experience in flood control, soils, dams. Desire responsible and challenging position. C-1097-Chicago.

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Planning Engineer, M. ASCE, CE, Registered in California, 39. Experienced in fire protection analysis and evaluation, water system, building and fire prevention codes. Preparation of reports on above. Many contacts with municipal officials in Western States. Salary, $10 000 a year. Location desired, San Francisco. Se-1902.

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Project Engineer, M. ASCE, CE, IE, 33. Three years of experience in charge of design of facilities for missile bases, twelve years of experience on supervision of design and construction, contracts, cost, budgets on bridges, buildings, sewers, highways, sewage treatment plants, tunnels, roads for city. Salary, $12,000 a year. Location desired, Northwest. Se-873.

Construction Superintendent, Designer, M. ASCE, CE. Professional Engineer License in New York and Ohio, 35. Eight years of experience in charge of construction design, inspection of bridges including falsework and form design, sheeting and shoring, refinery units, foundations, and super structures for contractors. Salary $12,000 a year. Location desired, West. Se-823.

Field or Office Engineer, M. ASCE, Professional License in North Carolina, 66. Experienced on design, estimates, reports, construction of military bases, public works, highways, industrial plants, commercial buildings, utilities. Location desired, San Francisco Bay Area. Se-677.

Structural and Civil Designer, M. ASCE, MinE, 59. Many years of experience on the design (structural, mechanical, civil) of ore treatment plants, large industrials and facilities, sewage treatment and mining ore treatment plants. Also charge of fire and safety equipment. Salary, $7800 a year. Location desired, San Francisco. Se-545.

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Construction Engineer, graduate, for heavy industrial construction. Work will involve field engineering, production accounting, contracting, estimating, and dealing with customers. Location, Chicago, Ill. area. W-9014.

Sanitary Engineer for large health department in rapidly growing county of 370,000. Bachelor's degree plus four years of experience required. Salary, $8,000-$9,762 a year, plus liberal sick leave, vacation and retirement benefits. Location, vicinity of Washington, D. C. W-8994.

Teaching Personnel, for civil engineering department with main interest in highways and surveying; M.S. with Ph.D. preferred. Salary range, $5,000-$9,000 a year, with salary and rank depending upon background and experience. Location, Ohio. W-8992(*b*).

Sanitary Engineer, graduate, with experience in design of pumping station, sanitary sewer systems, treatment plants and preferably design water distribution, for consulting engineering firm. Company pays placement fee. Salary, about $10,000 a year. Location, Virginia. W-8882.

Soils Engineer for a firm which specializes in soils engineering. Duties will primarily be in the field of logging and sampling of undisturbed soils for foundation investigations. Occasionally, laboratory and office work required. Location, southern California. W-8959.

Engineer, graduate civil or mechanical, preferably with a professional engineer's license, with from five to ten years of experience in the construction business, who is interested in new innovations in new building. One half of time will be spent working on new type approaches and different innovations; other half of time will be spent in field acting as liaison and following through on the job. Salary, $10,000-$12,000 a year. Location, New York City. W-8952.

Engineers. (*a*) Soils engineer, master's degree in soil mechanics, registration desirable but not necessary, for position as assistant manager in growing foundation engineering and testing corporation. Profit sharing. (*b*) Civil engineer, with experience in sub-division engineering and layout of facilities. Location, Midwest. W-8950.

Irrigation Design Engineer, graduate engineer, with a minimum of 7 years of design background, preferably on major irrigation projects. Must be able to design small drop structures, irrigation turnouts and drainage pumping plants. Salary, to $13,200 a year, plus allowance. Duration, 18 months or longer; can take family. Location, Middle East. F-8942.

Operating Vice President for a multi-plant water works utility system. Must be qualified administrator capable of assuming full responsibility for planning and directing both operations and construction programs. Must have proven practical experience and technical background required for efficient direction from administrative headquarters of local supervisory personnel. Submit resume containing a detailed description of all present and prior responsibilities, include present earnings, and list three references. Location, East. W-8934.

Assistant Professor, highway construction, graduate civil, with two to five years of field and office experience in highway, design construction and survey. Teaching experience highly desirable. Should be qualified to teach surveying, highway plan reading, highway drafting and layout, highway design. Salary, $6,020-$7,520 a ten-month academic year. Extra compensation for evening school instruction. Location, New York suburban area. W-8886.

Structural Engineer, B.S.C.E. (structures), eight years' experience, some of which should be in the design and layout of elevated steel water tanks, bins, vats, etc. Knowledge of structural design and fabrication. Excellent chance for management duties and promotion to one of high responsibility. Will have to be able to design and plan layout of these structures for the fabrication shop for construction of steel structures and to assume responsibility for the engineering of these structures. Employer will negotiate placement fee. Salary, to $12,000 a year. Location, Indiana. C-8086.

Sales Engineer, engineering degree, with two or more years of experience in operation or design of water and waste treatment equipment, knowledge of water treating or Ion exchange or inorganic waste treatment equipment. Will engineer a treatment system, based upon customer's inquiry, using standard equipment, write sales letter to customer, with quotation on equipment applied. Employer will negotiate placement fee. Salary, $9,000-$10,000 a year. Location, Southwest Chicago suburb. C-8045.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

Designer, must have experience with wood, preferably components or sandwich panels, particularly in housing field. Salary, $8,400 a year. Location, Pacific Northwest. Sj-5226.

Junior Civil Engineer, recent CE graduate, interested in dredging profession as a career, who could be trained and developed for eventual supervisory capacity with engineers and contractors. Salary to start, $6,000-$6,600 a year, depending on prior experience. Subsistence allowance for locations other than San Francisco Bay Area. Headquarters, San Francisco. Sj-5204.

Junior Civil Engineer, graduate civil or structural engineering, or experienced draftsman well versed in basic mechanics, strength of materials and college mathematics. Will be trained in drafting room, preparation of shop drawings; later trained in timber design and cost estimation for fabricator of structural glued laminated timbers for engineered structures. Minimum starting salary $6,000 a year. Location, Pacific Northwest. Sj-5258.

Sanitary Engineer, preferably graduate, 25-50. With two years of experience on sewage treatment, water treatment, industrial wastes, sewers, water pipeline (all or part). Knowledge of hydraulics, piping, mechanical equipment as applied to water and sewage treatment and familiarity with reinforced concrete and electric layout desirable. To design or assist with design of water-sewage treatment plants, pump stations, sewers, water storage and distribution systems and supervise construction inspection. Salary, $7,800 a year or more, depending on experience. Location, Southern California. Sj-5257.

Designer, Estimator, CE, to 35. Ten to twelve years of experience in medium and heavy building (industrial, utility, military). Should be able to meet with clients and represent general contractor in negotiations. Must be familiar with design, field superintendence and completely familiar with estimating, take-off, material listing, pricing and bidding. Excellent opportunity. Salary, $9,600-$12,000 a year to start. Location, Utah. Sj-5256.

Structural Designer, CE or equivalent, preferably registered in California. Three years of experience on structural design for design and inspection of structural steel, reinforced concrete, masonry and timber structures including bridges, culverts, retaining walls, warehouses and related structures. Salary, $7,764-$8,148 a year. U.S. citizen. Location, Southern California. Sj-5250.

(*a*) **Soils Engineer,** preferably registered engineer with CE degree. Minimum of three to four years' experience in soils foundations work and lab work on soils test. Salary, about $7,200 a year or more, depending on experience and qualifications. (*b*) **Engineering Aide,** one to two years of experience in soils mechanics; able to do work with minimum supervision. Salary, $6,000 a year or more, depending on experience. Location, San Francisco Bay Area. Sj-5236.

Superintendent, to 45, with at least five years of experience in sewage and water treatment plants and some experience in industrial construction. Salary, about $9,100 a year or more depending on experience. Location, San Francisco. Sj-5229.

Sewer Design And Construction

A joint ASCE-WPCF (*formerly FSIWA*) committee has worked for several years to produce the latest in the series of Manuals of Engineering Practice. Copies of this manual can be obtained by completing the accompanying coupon. The list price is $7.00 and ASCE members are entitled to a 50% discount.

---------- CUT HERE ----------

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STATICS OF SOIL MEDIA

By V. V. SOKOLOVSKI

Academy of Sciences, U.S.S.R.

Translated by D. H. Jones and A. N. Schofield. **$10.50**

Though Professor Sokolovski's work in the field of plasticity is well-known to research workers, this English translation will render his work accessible to a wider audience and enable engineers to become acquainted with current theoretical research in problems of plastic failure. Many of the mathematical problems encountered in the analysis of stability of foundations and of slopes, and in the design of embankments and of fills can be treated by purely statical considerations and the book is devoted to an examination of these problems.

Descriptive leaflet available upon request from:

BUTTERWORTH & CO. (CANADA) LIMITED
1367 DANFORTH AVENUE, TORONTO 6, ONTARIO

Compare the clean, simple lines of this structure with the heavier, haunched construction apparent in elastically designed buildings. Savings accrue through faster, easier, prefabricated construction as well as through lighter weight steels.

There's an Inland Structural Steel for every new construction idea

Plastic Design is today more and more coming into widespread use in one and two-story rigid-frame structures. It presents welcome opportunities for reducing labor, time and material costs, for plastic design is based not upon the concept of maximum stress of a member—but upon the *load-carrying capacity of the entire structure.*

In elastic design, the entire member must be designed for the maximum moment. In plastic design, since the moment is distributed to the structure as a whole, no single member need be over-designed and substantial savings—from 5% to 35% in labor and materials—are possible. In addition, since the more indeterminate the structure the greater the saving, design time can actually be reduced by as much as 80%.

If you are contemplating the design or construction of a new building, remember that plastic design is applicable only to a ductile metal such as steel. The considerable savings possible, make it well worth your careful investigation.

Plastic design is accepted by all four National Building Codes as well as many state and municipal codes. For complete information on this modern, cost-cutting construction method, see your local fabricator who now has structural steel available in all shapes and sizes—or call the American Institute of Steel Construction office in your area.

Use Steel *For Modern Construction*

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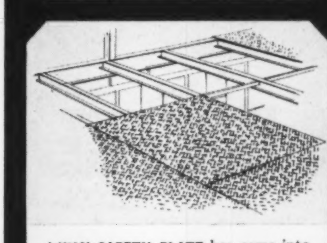
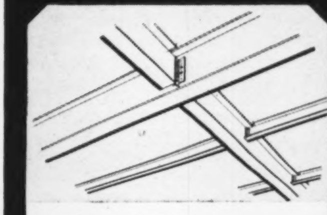
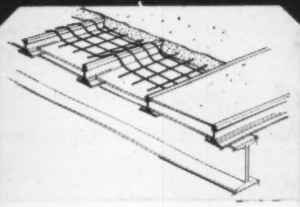


4-WAY SAFETY PLATE has come into general use as an integral, prefabricated part of the supporting structure, providing durable floors and added strength.



WIDE FLANGE BEAMS are the answer wherever more strength with less weight, longer spans with more open floor area, is the goal. Sizes from 8′ to 24′.

INLAND ENAMELING IRON is ideally suited to curtain-wall and enameled panel systems, providing strength, beauty and unlimited design possibilities.



INLAND SUB-PURLINS are especially designed to provide a lighter, more efficient member for shorter-span roofs. They come cut-to-length and mill painted.

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INLAND STEEL CO.
30 West Monroe Street
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New Publications

Traffic terminology . . . . For the first time the different vocabularies in the traffic field have been consolidated in a single volume and published by the Northwestern University Traffic Institute. The book, "Dictionary of Highway Traffic," is aimed at improved communication among technical and specialized groups in the field. It will be useful to a wide range of personnel—from highway planners and traffic engineers to administrators and law-enforcement officials. Copies of the 300-page dictionary, priced at $6.00, may be obtained from the Director of Publications, Traffic Institute, 1804 Hinman Avenue, Evanston, Ill.

Cement mortar standard . . . . One of the important recent developments in the construction field is dry-set Portland cement mortar for the installation of ceramic tile. The industry estimates that in 1959 more than 50,000,000 sq ft of tile were installed with this material. The material affords great savings by permitting direct installation of tile over concrete block and other rough surfaces. The American Standards Association (10 East 40th Street, New York 16, N. Y.) announces the availability of a new American Standard Specification in the field (A118.1-1959), which may be purchased from the ASA at 50 cents a copy.

Welding . . . . Publication of the Third Section of the fourth edition of the "Welding Handbook" is announced by the American Welding Society. The 512-page volume covers special welding and metal joining processes as well as arc cutting, and includes new material on adhesive bonding and the welding of plastics. Ultrasonic welding, one of the important new processes, is also discussed. A descriptive leaflet is available without charge from the American Welding Society, 33 West 39th Street, New York 18, N. Y. Copies, obtainable also from the AWS, are $9.00 each.

Sewage disposal . . . . The Cincinnati (Ohio) Division of Sewage Disposal has released a comprehensive report of its operations in 1959. The report describes the 120-mgd Mill Creek Sewage Works, placed in partial operation for testing purposes in November, and the 7-mgd Muddy Creek Sewage Works, scheduled to be in operation by late 1960. Inquiries about the report should be sent to the Department of Public Works, Division of Sewage Disposal, 1600 W. Gest Street, Cincinnati 4, Ohio.

Nuclear studies . . . . For the convenience of industry and other groups needing concise summaries of current developments in the atomic field, the Atomic Energy Commission is publishing a quarterly series of Technical Progress Reviews. Two recent reviews deal with "Nuclear Safety" and "Power Reactor Technology." The reviews may be purchased by annual subscription ($2.00) or by individual issue (55 cents). They are available from the U. S. Government Printing Office, Washington 25, D. C.

Structural steel members . . . . A new (1960) edition of the Specification for the Design of Light Gage Cold-Formed Steel Structural Members replaces the 1956 edition of the same specification. An increase in the basic design stress from 18,000 psi to 20,000 psi for steels having a yield point of 33,000 psi is one of the important revisions in the new specification. The specification will now be applicable to the design of structural members cold formed to shape from steel sheet or strip of all thicknesses produced, up to approximately ¼ in. Copies of the revised specification are available from the American Iron and Steel Institute, 150 East 42nd Street, New York 17, N. Y.

Highway research . . . . A wide range of research work on roads and related problems is reported by the Highway Research Board in its continuing series of bulletins. Currently available are Bulletin 237, a compendium of 1959 highway laws, which sells for 60 cents; Bulletin 238, which contains seven progress reports on testing and theory of experimental continuously reinforced concrete pavements, $2.00; Bulletin 239, dealing with physical and chemical properties of cement and aggregate in concrete, $1.20; and Bulletin 240, reporting highway accident studies, $1.00. Also available is Special Report 53, the 1959 revision of state highway organization charts, priced at $1.60. Orders should be sent to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C.

Beach erosion . . . . Wave action as it affects the coasts of the United States and waterfront installations is the subject of three recent publications of the Beach Erosion Board, released as Technical Memoranda of the Corps of Engineers. These publications are Technical Memorandum No. 108, "Surf Statistics for the Coasts of the United States"; Technical Memorandum No. 109, "Laboratory Data on Wave Run-up on Roughened and Permeable Slopes"; and Technical Memorandum No. 111, "Large-Scale Tests of Wave Forces on Piling." Inquiries should be addressed to the Beach Erosion Board, Office of the Chief of Engineers, Washington 25, D. C.

Urban renewal . . . . Engineers and others concerned with Federal requirements applicable to local public agencies carrying out slum clearance and urban renewal projects will be interested in the Urban Renewal Manual entitled "Policies and Requirements for Local Public Agencies." The manual is available through the Superintendent of Documents (Government Printing Office, Washington 25, D. C.), on a subscription basis. Subscriptions ($15, domestic; $19, foreign) will cover the initial release and all revisions for the following two-year period.

River basin planning . . . . "Sequence and Timing in River Basin Development" is a 40-page economic analysis of river basin planning and project evaluation. The author, John V. Krutilla, uses the joint United States-Canadian development of the Columbia River Basin to demonstrate the theory that the proper sequence of project additions to a system must be determined before the contribution of a particular project can be estimated. The booklet may be obtained from Resources for the Future, Inc., 1145 Nineteenth Street, N.W., Washington 6, D. C. It is 75 cents.

Highway safety . . . . Availability of the fourth in a series covering a continuing study of the effect of enforcement on motor vehicle accidents and driving speeds is announced by the Traffic Institute of Northwestern University. The study was carried out by the Institute in cooperation with the U. S. Bureau of Public Roads. The report—written by Robert P. Shumate and identified as Project No. 533—may be obtained from the Field Service Division, International Association of Chiefs of Police, 910 17th Street, N.W., Washington 6, D. C.

Expressways and land values . . . . How expressways have affected land values in the Dallas, Houston, and San Antonio areas is the subject of Reprint No. 7 issued by the Texas Transportation Institute of Texas A. & M. College. The author is William G. Adkins. Inquiries should be sent to the Texas Transportation Institute, Texas A. & M. Colege, College Station, Tex.

Compost . . . . The entire field of large-scale composting will be covered in a new quarterly journal entitled "Compost Science." Sanitary engineers will be especially interested in composting as a means of converting municipal and industrial waste into useful products. Articles in Vol. I, No. 1 range from the story of how Schenectady, N. Y., sells its sludge to materials-handling methods for city composting. Subscriptions ($4.00, domestic; $4.50, foreign) may be obtained from the Rodale Press, 33 East Minor Street, Emmaus, Pa.

American standards . . . . The 1960 Price List and Index of American Standards, just off the press, includes the 1,800 American Standards approved to date. Fields covered include civil engineering, construction, abbreviations, symbols, materials handling, and safety, to mention a few. The listing also includes the international standards recomendations of the International Organization for Standardization. The Price List and Index may be obtained from the American Standards Association, 10 East 40th Street, New York 16, N.Y.

SPECIAL!

ENGINEERS' INFORMATION SERVICE

As a further service to our readers we will periodically make available this new system which greatly simplifies the procedure for obtaining additional data on advertised products, new developments reported by manufacturers in "Equipment, Materials and Methods and Literature Available." Instead of writing separately to each manufacturer, you need only circle the items you would like to receive on the coupon printed below and mail it to:

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For information on products advertised in this issue, circle the appropriate page number on the left-hand coupon; for items listed in "Equipment, Materials and Methods and Literature Available," circle the appropriate key number listed on the right-hand coupon. In addition to your name and address, be sure to include your title and firm name on the coupon. All information will be sent directly to you from the manufacturers. *Not good after August 15, 1960.*

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June, 1960—Equipment, Materials, Etc.

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Self-Trailing Roller

Hydraulic operation of self-trailing wheels for maximum portability is offered by the new Model 650-C two wheel tandem roller, produced by Essick Manufacturing Co. Weighing from 4½ to 6½ tons, the tandem increases the number of the company's tandem rollers available to 15 models and offers self-trailing for the size roller most normally requiring portability.

During rolling operations, the travel wheels are retracted upward to a high position, offering maximum clearance. For the few instances where close wall clearances are necessary, the travel wheels can be quickly and easily removed. Heavy steel construction and positive 3-way wheel support lock insures maximum safety during all types of trailing situations. —CE-1

"Short Leg" Clamp

This latest material handling device, developed by Merrill Brothers, was designed with this "short leg" feature in order to provide a secure bite on even small junior size beams. The use of this 2-Ton Structural Clamp eliminates time lost in slinging, attaching and releasing work in the process of moving.

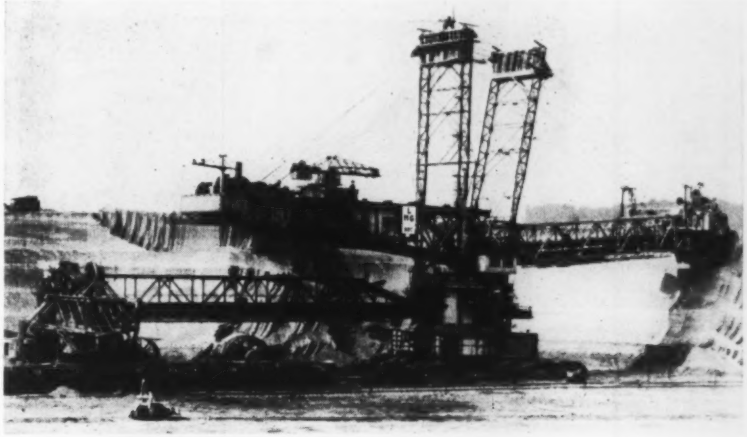
Completely drop forged, it is extremely light in weight in relation to its capacity. The clamp has a grip range 0-1 in., is 100% proof tested at 6 tons and has a safety factor of 5 to 1. —CE-2

Batching Console

A new, compact batching console featuring a remarkably simple system for pre-setting multiple formulas and operating batching plant remotely has been introduced by Noble Co. Up to 10 different formulas of 10 different materials can be pre-set in advance; additional formulas in increments of 10 are optional. The selection of formula or change from one formula to another is immediate. Individual remote dials permit reading of up to 8 corresponding dial scales on batch deck, enabling the console to be positioned remotely in yard office, at mixer truck charging station or at any other desired location.

The electronic components of the console are convenient sub-assemblies, easily interchangeable. Unlike vacuum tube systems, the all-transistorized elements are not effected by vibration. The console can be installed on existing concrete batching plants and easily maintained by the ready-mix producer or contractor's own personnel. Standard unit is equipped with full batch-start and batch-dump interlocks. —CE-3

Bucket Wheel Excavator



Designed and built in Germany for excavating overburden and brown coal in the large German open pit mines, these bucket wheel excavators are now used in many other parts of the world because of their operating economies. Made in a wide range of sizes, they are particularly suited to high capacity operation—some handle up to 13,000 cu yd per hr (nearly 300 sixty-ton coal cars).

Distributed in the United States by Link-Belt Co., the bucket wheel excavator is essentially a crawler-mounted self-propelled machine with a digger which consists of a large vertical wheel with steel buckets mounted on the periphery. The wheel itself is mounted on a boom which permits it to be raised or lowered; on some models the boom can also be thrust forward and retracted. A receiving belt conveyor delivers to a loading belt conveyor on the excavator which in turn discharges material onto belt conveyors or into cars or trucks.

The digging buckets scoop up the material as the wheel boom rotates, discharging it to a boom belt for delivery to the boom discharge belt. On most wheels the buckets discharge to a rotary table-type feeder which revolves horizontally within the vertical wheel for discharge to the boom belt. An important feature is that the digging wheel boom and the belt conveyor discharge boom rotate independently. The material can be discharged at a single point on a field belt conveyor while the wheel boom is rotating through its digging range. —CE-4

Concrete Gun Rig

The introduction of two new rigs designed to speed placement of concrete in a wide variety of jobs and applications has been announced by Ridley & Co., Inc.

Versatility is the keynote in the two rigs since they make possible quick, simple repairs of damaged concrete work and at the same time have the capability of supplying full concrete gunning capacity for construction work of all kinds with minimum crews. The combination of saving time and labor costs makes possible substantial reductions in the price of placing concrete.

Model C3VM (truck-mounted) and C3TM (trailer-mounted) will shoot concrete at a rate of from 8 to 12 tons per hour employing a 365 CFM compressor. They are extremely compact and have reached a point of simplicity that makes crew training very simple. They are provided with a highly efficient paddle mixer mounted 25 to 30 inches high for easy, efficient shoveling which feeds into a belt elevator which in turn conveys the mix to a hopper at the top of the gun itself. The result is compact, continuous feed operation which allows a minimum crew to shoot as little as a one sack batch or ton after ton of concrete. —CE-5

This man is replacing dollars with sand!

The soil compaction job for the Boise-Cascade Corp. plant site proceeded at a rate of 4,000 cubic feet of soil compacted per hour with two Vibroflot machines. Each compaction consumed 3 or 4 tons of sand.

100 plus contracts have proved that

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From Vancouver to Maine, from Newfoundland to Florida, architects and engineers have stretched their building budgets by specifying soil compaction by VIBROFLOTATION.

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EQUIPMENT MATERIALS and METHODS

(continued)

Giant Stripping Shovel

WHEN COMPLETED, THE GIANT 3850-B excavator now being built by Bucyrus-Erie Co. will remove 36 million yards of overburden annually; the 115-cu yd dipper will take a 173-ton bite each time.

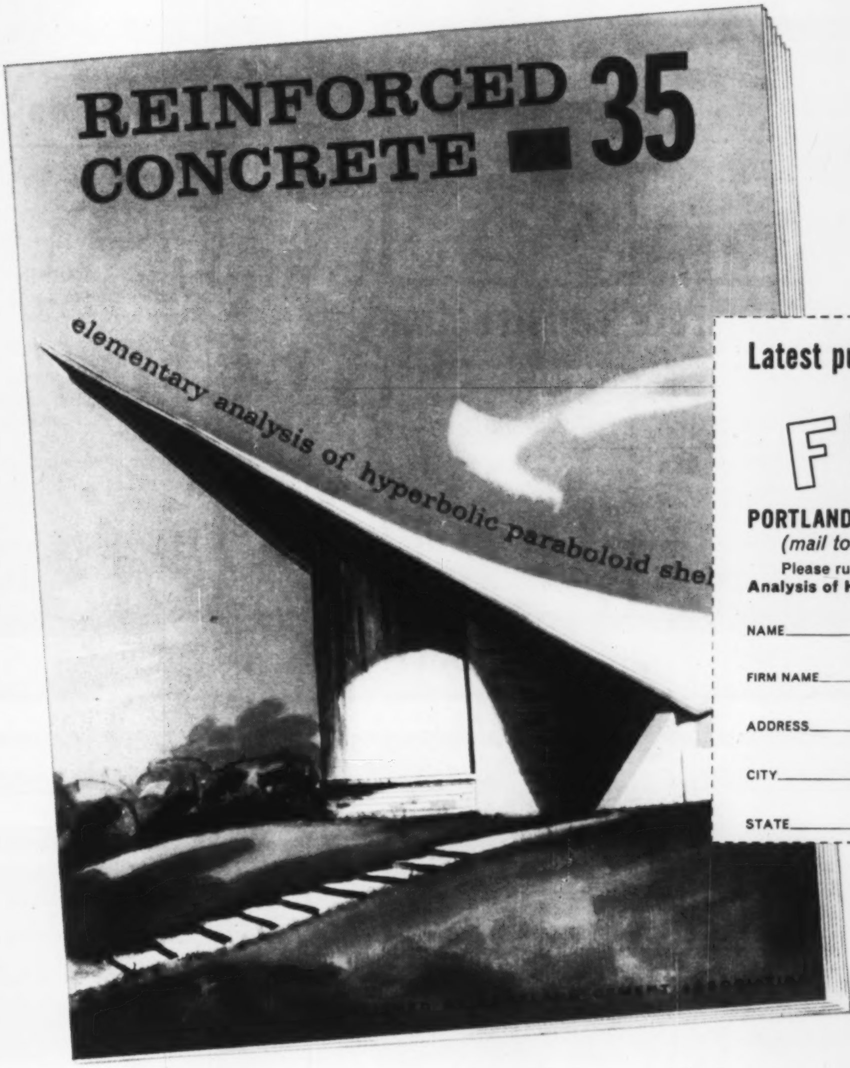
The machine will require 4,000 gal of hydraulic fluid for its hydraulic system, and will contain 50 electric motors ranging from ¼ to 3,000 hp. Its working weight will be 14,000,000 lb, equal to 4,500 family automobiles. A half million cubic feet of air per minute will be needed for motor cooling—equal to air output per minute of 500 twelve-inch household fans. It will stand as high as the deck of the Golden Gate Bridge, tower 56 ft higher than the Statue of Liberty and 45 feet higher than Niagara Falls and be under the guidance of a single operator, who will survey the area five stories up in his air-conditioned cab, which he will reach by a passenger elevator. —CE-6

3850-B

Spray-on Damping Compound

A NEW, VISCOELASTIC MATERIAL which, when sprayed or trowelled onto metal plate, drastically reduces structurally borne noise and vibration has been announced by The Korfund Co., Inc. The compound renders metal plate acoustically equivalent to a sheet of cork.

Until now, the emphasis has been upon developing very efficient airborne sound absorbing materials, with little attention being paid to structure borne noise. With the introduction of the new compound, a highly effective, economical treatment is available for sheet metal applications such as air ducts, pleums, curtain walls, business machines, computers, transformers, metal doors, pumps, fan scrolls, and vibratory feeders. —CE-7



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PORTLAND CEMENT ASSOCIATION
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Please rush my copy of **Elementary Analysis of Hyperbolic Paraboloid Shells**

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Engineering design procedure for concrete hyperbolic paraboloid shells

Of special interest to engineers is PCA's new booklet, "*Elementary Analysis of Hyperbolic Paraboloid Shells.*" It's an authoritative presentation of design fundamentals and HP geometry. Design data are included for standard, skewed, groined and sloping HP's. For your free copy, fill out coupon and mail to nearest PCA district office listed below. (U.S. and Canada only.)

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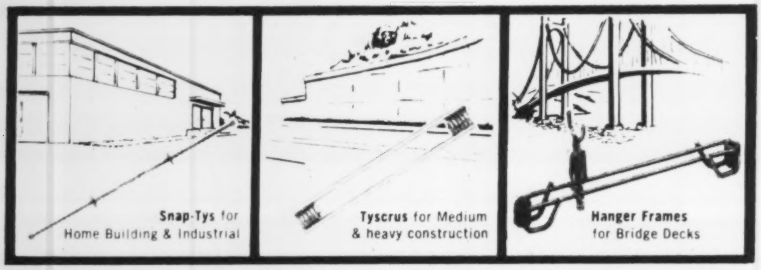
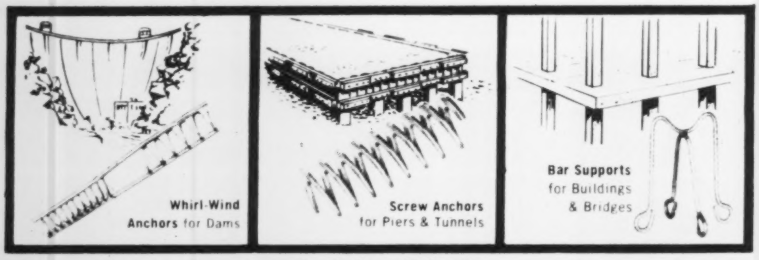
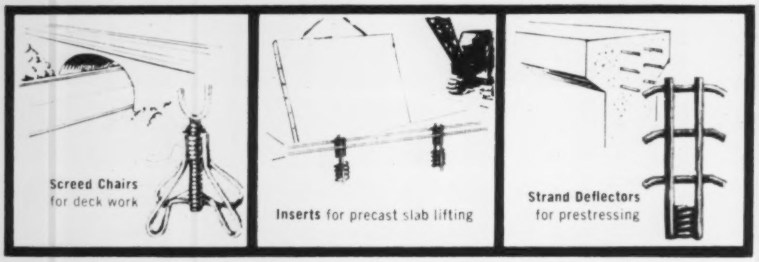

Snap-Tys for Home Building & Industrial
Tyscrus for Medium & heavy construction
Hanger Frames for Bridge Decks

For every kind of concrete construction


Whirl-Wind Anchors for Dams
Screw Anchors for Piers & Tunnels
Bar Supports for Buildings & Bridges

there's a dependable Richmond product!


Screed Chairs for deck work
Inserts for precast slab lifting
Strand Deflectors for prestressing

Richmond has learned, through years of practical experience and research, how to design and produce the most effective and economical form ties, anchors, inserts and accessories for every conceivable kind of concrete construction.

All Richmond-engineered products, and there are more than 400 in the complete line, are designed to provide the extra strength that assures a safe, dependable forming job while saving time and money.

In addition, Richmond's field representatives and Technical Department can help you with any problem you might encounter in planning your form work . . . and will provide you with estimates, "take-offs" and material specifications on request.

Richmond's line of laboratory-tested form ties, anchors, inserts and accessories is the largest—in the field. It provides you with one source for all your concrete forming needs . . . ask for, and insist on "Richmond".

For complete information about Richmond's full line of quality products for concrete constuction—or assistance with any specific concreting problem, write to:—

Richmond
SCREW ANCHOR CO., INC.
INSIST ON RICHMOND
. . . AND BE SURE IT'S RICHMOND

Main Office: 816-838 LIBERTY AVENUE, BROOKLYN 8, N. Y.
Plants & Sales Offices: Atlanta, Georgia; Fort Worth, Texas; St. Joseph, Missouri. **In Canada:** ACROW-RICHMOND LTD., Orangeville, Ontario.

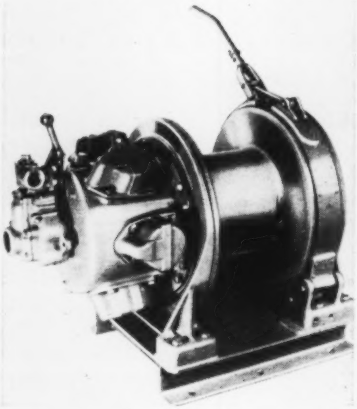
EQUIPMENT MATERIALS and METHODS

(continued)

Utility Hoists

Two NEW AIR POWERED utility hoists capable of handling maximum loads of 7000 and 5000 lb have been developed by Ingersoll-Rand Co. Called K6U and K6UA Single Drum Utility Hoists, they are said to have greater capacity than any other single-drum air hoist and retain the same portability and adaptability of small units.

The hoists are designed to handle the heavier loads on erection, maintenance and materials handling jobs, without multiple reeving. Both are equipped with reversible six cylinder air motors with infinite speed graduation provided by the throttles. A self-energizing brake supplements the reversible motor for positive control.



Portability and Adaptability

At 80-psi air pressure, the Size K6U has a rate capacity of 7000 lb with average lift speed of 65 ft per minute. The Size K6UA is rated at 5000 lb and 95 fpm. Drum capacity of the two units is 600 ft of 5/8-in. wire rope or 400 ft of 3/4-in. wire rope. —CE-8

Power Pumps

FOUR NEW HEAVY-DUTY hydraulic power pumps developing 10,000 psi continuous pressure and designed especially to drive rams, jacks, presses, and similar hydraulic units, are announced by Greenlee Tool Co.

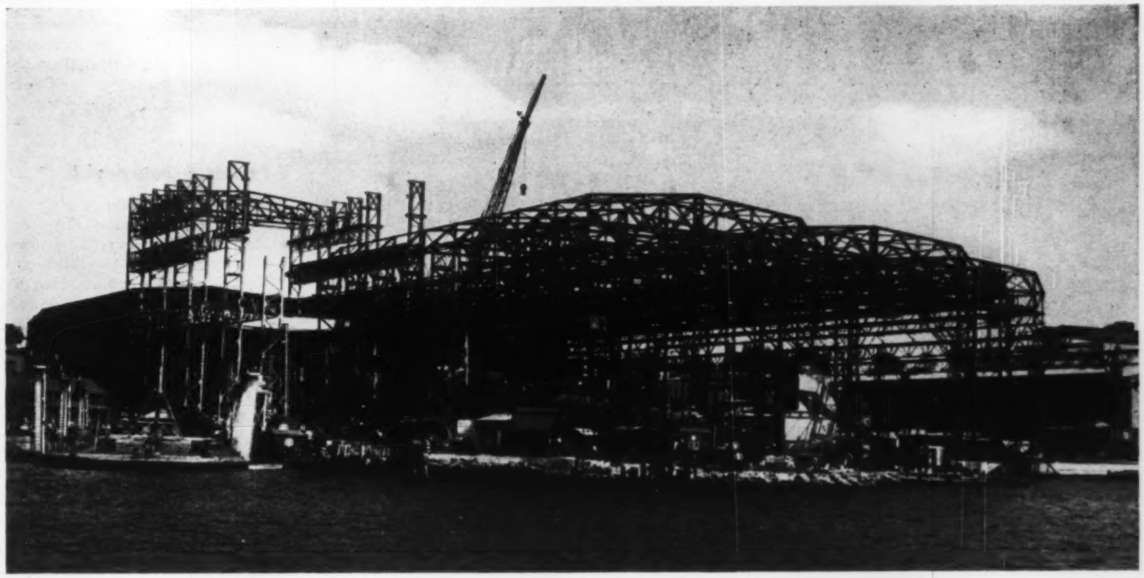
Powered by a self-contained 3/4-hp, 115-230 volt, a-c, single-phase, constant-speed (1725 rpm) capacitor-type electric motor, the No. 1721 Series power pumps have

(Continued on page 142)

Launching Ways For U.S.S. George Washington

Supported an COBI PILES

DRIVEN BY C. L. GUILD



In the foreground—one of the Guild pile driving rigs on the job driving drilled-in-caissons to support launching ways

ON June 9, 1959 the U. S. S. George Washington, America's first Polaris missile firing submarine, slid down the launching ways at the Groton, Conn. yards of General Dynamics Corporation's Electric Boat Division.

During the past four years C. L. Guild has installed the foundations for five launching ways at Groton. A total of about 800 Cobi piles and 170 drilled-in-caissons were placed.

All the piling was driven under "crash" conditions, driving through heavy ground and very difficult soil conditions.

Guild engineers, whose training and knowledge have been proved on some of the toughest pile driving jobs in the country, can help you with your foundation problems. There's a Guild office near you.

The U. S. S. George Washington

C. L. GUILD CONSTRUCTION CO., INC.

90 Water Street, East Providence 14, R. I.

BOSTON, MASS.
SYRACUSE, NEW YORK
WASHINGTON, D. C.
ATLANTA, GEORGIA
HOUSTON, TEXAS
KANSAS CITY, MO.

a pumping capacity of 150 cu in. per minute at pressures up to 150 psi and automatic change-over to 30 cu in. per minute up to 10,000 psi.

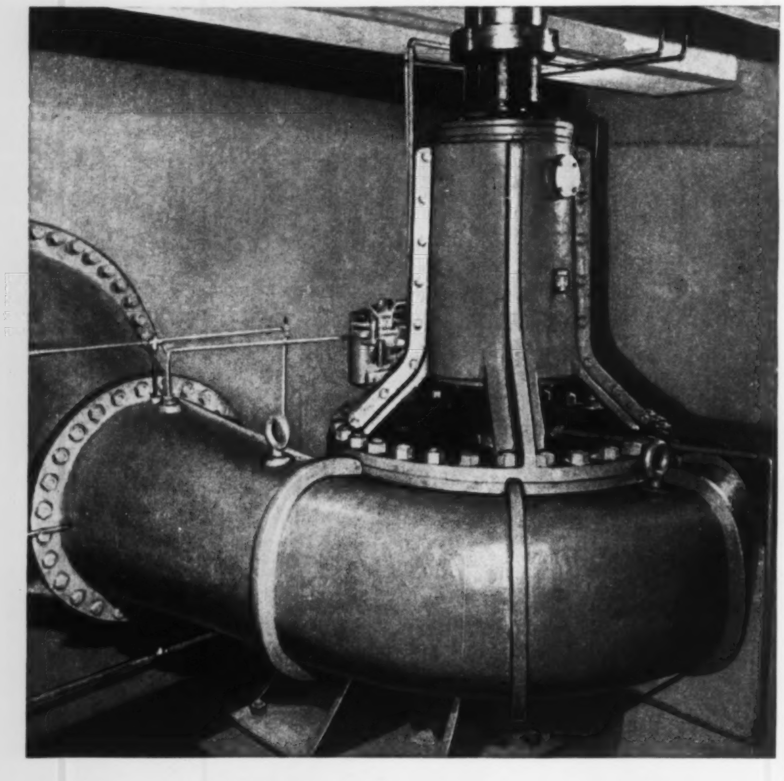
Usable oil volume in all four models is 260 cu in. The motor can be started under load, while the ram is held in position under pressure. Pumps are finished with an outlet block having two ⅜ in. npt and pipe outlets for pressure take-off and return. **—CE-9**

New Diamond Blade

THE BD-340 DIAMOND BLADE manufactured by The Eveready BrikSaw Co. for use on all masonry saws, is designed for extra long life when cutting light weight, concrete and cinder blocks as well as many types of firebrick such as "first quality" and "basics."

The new Ready-Cut specification is also an excellent choice for alternate cutting of glazed tile, brick, and other dense materials when most of the cutting on the job is block.

Because of the low cost per cut, contractors will find the BD-340 to be the most economical blade to use on large jobs where several saws are used and where it is desirable to have a diamond blade for every saw, the manufacturer states. Also it will be the first choice on small jobs where only one low-cost diamond blade is to be charged against the job, it is further stated. **—CE-10**



the bigger your pumping problems... the better your reasons for giving them to WHEELER-ECONOMY

The entire C. H. Wheeler organization is geared to the design, development and production of high-capacity pumps.

Pumps like the one you see here, for example—one of three 36″ x 30″ Vertical Mixed Flow Volute Units installed at the Wapato Irrigation Project, State of Washington. These Pumps handle larger volumes at lower first cost than any other kind of pumping equipment!

Wheeler-Economy Axial and Mixed Flow Pumps range in capacity from 5,000 to well over 220,000 gpm; in head from five to 75 ft. See your W-E representative or write direct for the pumps you need, *specifically designed for your application.*

Economy Pump Division

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pa.

Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear Products

V-Power B Tournapull

WITH THE INTRODUCTION OF a new 430-hp V-12 diesel engine as standard equipment, the Model B Tournapull becomes a big 29-yd companion to the high-performance "V-Power" C, manufactured by Le Tourneau-Westinghouse Co.

The 28% increase in horsepower that the V-Power B has over the previous model with standard "in-line" engine accounts for an astonishing improvement in overall performance. Acceleration time is cut by nearly a third as the machine comes out of the cut and gets up to haul speed. The extra power is felt too in faster loading and superior gradeability. The operator finds that far fewer downshifts are necessary even in steep going under full load.

V-Power B

The high-inertia steering motor automatically provides two rates of steer, slow for controlled "no-whip" steering at high-travel speed on the haul road, and quick sharp steer when it is needed for maneuvering in tight places or making tight turnarounds in the pit or on the fill. With the new system the operator can swing the nose of the prime mover 180 deg from full left to right at about twice the speed as on the previous model. **—CE-11**

Guard Rail Stanchion

A NEW, ALL-STEEL guard rail stanchion has been developed by Superior Scaffold Co. to fill a vital safety need and serve as a temporary guard rail around the perimeter of floor slabs, bridges, stair and

(Continued on page 144)

Designed for today's concrete placement techniques

Uni-Form Panels have changed over the years to keep pace with modern concrete forming practice.

Today's Uni-Form Panels weigh a little more (about ½ lb. per foot) than other pre-fab form panels because *they are designed and built to meet today's requirements.*

We know that if the assembled concrete form is to have the structural rigidity necessary to withstand today's concrete placement techniques and high rates of pour, the individual panels which make up the form must have great inherent strength.

We produce the strongest form panel we know how to build. The great strength—and extra weight—of Uni-Form Panels is due almost entirely to the special "T" section steel frame which supports the struts or load bearing members of the panel.

Most specification concrete does not permit deflection in the forms. If the form panel does not have the strength to take the stresses imposed by normal concrete construction practices, it is a liability that can cause serious problems.

Uni-Form Panels are designed to take the full strength of the tie, plus a wide safety factor to avoid any possible deflection or permanent set in the load bearing member. Concrete formed with Uni-Form Panels will be straight and true.

Because they are so strong, you don't have to "baby" Uni-Form Panels. *You don't have to make major changes in your method of handling and placing concrete.* You can apply the heaviest practical pressures and highest pouring rates to a Uni-Formed concrete form with assurance that it will stand up and take it.

When you rent or buy any pre-fab form, it will pay you to consider carefully what you're getting. If you want a panel that is built to give you maximum forming speed, economy, efficiency, and service life—look to Uni-Forms. More contractors are using them every day because Uni-Forms deliver where it counts . . . on the job.

Write for the UNI-FORM Panel Catalog. It contains complete details on the industry's most modern and flexible concrete forming system.

"Products from the Gold Tool Room"

UNIVERSAL FORM CLAMP CO.
1238 N. KOSTNER AVENUE · CHICAGO 51, ILLINOIS

BRANCH OFFICES and WAREHOUSES:
ATLANTA BALTIMORE CLEVELAND HOUSTON
LOS ANGELES SAN LEANDRO TORONTO

DOWN TO FUNDAMENTALS

SMALLER AND BETTER

KERN'S NK3 Precise Engineers' Level. The world famous engineering tool especially designed for accurate leveling.

The NK3 offers over 100 years of Swiss Master Craftsmanship and the latest technical achievements compressed into 4 lbs. of maximum precision, operational efficiency and economy.

- **Mean leveling accuracy per mile (normal conditions) ± .008 Ft.**
- **Coincidence bubble is viewed directly through 30X telescope, allowing constant check on bubble centering while reading rod.**
- **Ready for use right out of the case. Highest precision leveling with coincidence spirit level and tilting screw. Coated optics give increased brilliance and contrast in the image.**

MORE RELIABLE READING IN LESS TIME!

Ask for Detailed Brochure NK527-2

SERVICE DEPARTMENT FACTORY TRAINED PERSONNEL

Kern SWISS *The FINEST in SURVEYING EQUIPMENT*

KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.

EQUIPMENT MATERIALS and METHODS

(continued)

elevator wells and similar above-ground building projects.

Ruggedly built, providing an even rail height of 42 in., the new stanchion meets all California safety requirements and accommodates either 2x4's, cables or ropes. A stanchion set-up requires no tools. The heavy Acme thread and handle provide a positive clamping action which affixes the stanchion to a slab of any thickness from 4 to 20 in. —CE-12

Short Turn Radius Tractor Shovel

A NEW HEAVY-DUTY, rubber tired tractor shovel with short turning radius designed principally for industrial bulk materials handling has been announced by Clark Equipment Co.

The "Michigan" Model 55B has a lift capacity of 5400 lb. Equipped with a one-yd bucket, the 15-ft 8-in. long tractor shovel has a turning radius of only 11 ft 2 in.

Capable of traveling at speeds up to 26 miles per hour in either forward or reverse, the Model 55B is powered by a 66.5 hp gasoline engine, and has bucket wheel drive with planetary gear reduction in the driving wheels.

55B
MICHIGAN

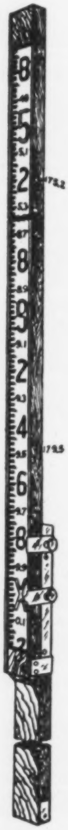
Model 55B

Like the all-wheel drive Model 55A Tractor Shovel the new model has the Michigan power train with torque converter and power shift, plus all other big machine features carried on larger Michigans of this type. It has a total working weight of 10,200 lb; maximum dumping height is 8 ft. —CE-13

Aluminum Towers

PORTABLE, SELF-SUPPORTING towers made of aluminum, in a direct gauge for gauge substitution for steel, are now dotting the country in a number of widely different applications. Manufactured by

(Continued on page 146)



For Efficiency and Economy

LENKER DIRECT READING LEVEL ROD

Every Rod Reading an Elevation

No Computations

Awarded Medal of Merit for Utility by Franklin Institute of Philadelphia

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599 CHESTNUT STREET
SUNBURY, PA.

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Contact us, or have your architect or consulting engineer tap our 70 years experience solving Waste Disposal problems—large or small. No obligation.

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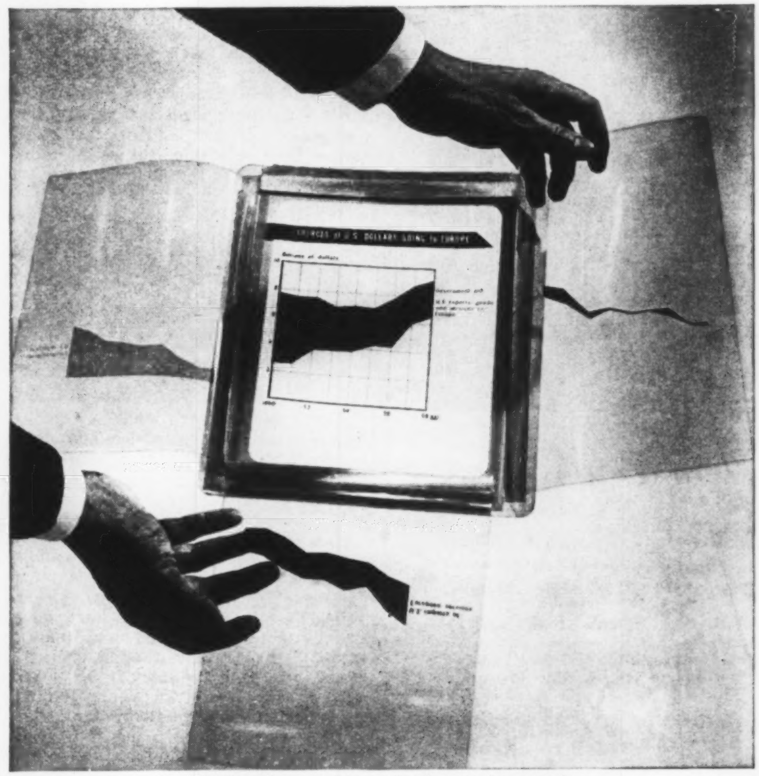
OZALID *NEWSLETTER*

NEW IDEAS TO HELP YOU WITH ENGINEERING REPRODUCTION AND DRAFTING



Ozalid Viewfilms produce color images in seconds . . . and at lower cost than conventional methods.

Need low-cost color in a hurry?

Four-color, three-color, or even two-color for that matter . . . no problem; Ozalid's Viewfilms provide the perfect low-cost answer.

Suppose we want to produce a performance chart in which each factor is a different color.

It's a snap. Just take translucent paper and draw the desired curve or dotted line (as the case may be) on the sheet.

Next, run the master through your Ozalid machine together with an Ozalid Viewfilm of the proper color. Want to add more material in a different color? Just prepare another master, select a different colored film, and run them as you did the first pair. When you're all through, overlay the films in sequence and tape them into register. Your result is a composite color chart that's very dramatic . . . very convincing!

This is just one illustration to start your mental salivary glands working. We are sure that you can find uses we haven't even dreamed of, once you get going. And if you discover any new applications for this best of all possible color worlds, tell us about them so we can spread the good news to others.

When it comes to cost estimating . . .

. . . there's nothing like a handy white-printer to cut preparation time of cost estimates, according to the Stackpole Carbon Company, St. Mary's, Pa. The company's Supervisor of Cost Estimating has just written us a letter on the subject which we pass on to you verbatim. "Our estimates are made in pencil on printed translucent vellum in pad form. These are reproduced on specially cut and punched Ozalid copy paper. Originals carry only basic information that has to remain constant. And from the originals we produce duplicate originals on Ozalid sepia line intermediate paper (#402 IT) as required, and these are used until the basic information is obsolete. To revise a cost, it is only necessary to add current rates and extend. With this simple Ozalid method we have eliminated typing, proofreading, and copying errors."

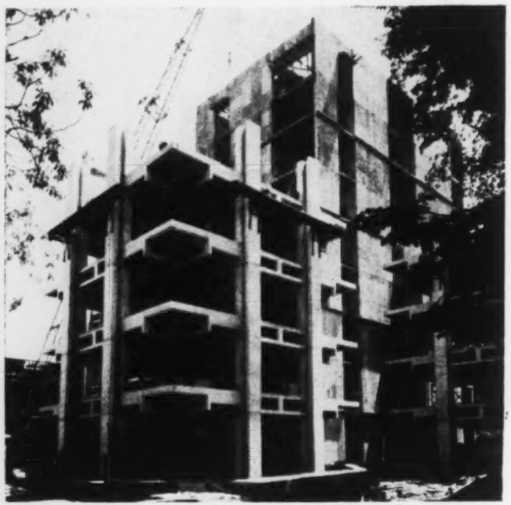
The Supervisor goes on to say that Stackpole uses Ozalid copying in many other areas of its business because of convenience and economy. Perhaps we'll be able to tell you about these uses in a future *Newsletter*.

Here's what 100 usable feet per minute can do for you

Speed up your production? Of course! But that's only the beginning. Look at it this way. One Printmaster 1000® working at a usable 100 feet per minute matches the output of several smaller, slower machines *but takes up less valuable floor space while handling widths up to 54 inches!* You save on production time and costs due to higher working speeds! And the Printmaster 1000 is probably the toughest, most durable unit ever produced. This means even greater savings in downtime and service charges. Our first recommendation for any shop having heavy work loads is this 100-foot champ . . . the Printmaster 1000.

Ozalid*—Division of General Aniline & Film Corp.• In Canada: Hughes-Owens Co., Ltd., Montreal*

STRESSTEEL was the solution to this Engineering Problem



Medical Research Center, University of Pennsylvania, Philadelphia.

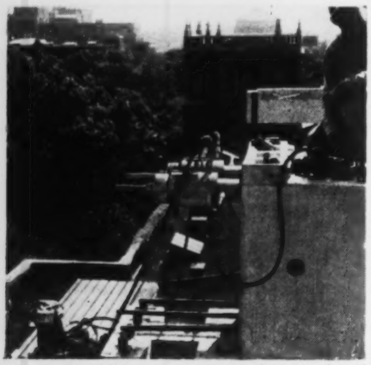
Louis I. Kahn, Architect: Keast & Hood and Dr. August E. Komendant, Structural Engineers.

Joseph A. Farrell, Inc., General Contractor.

Atlantic Prestressed Concrete Co., concrete units.

THE PROBLEM: How to assemble and prestress in place, 8 precast concrete segments in each floor system of a 7 story clear-span Vierendeel frame building, with maximum efficiency and minimum cost.

THE SOLUTION: Post tension with STRESSTEEL, taking advantage of the inherent rigidity of STRESSTEEL Bars and the simplicity of STRESSTEEL Wedge Anchors.



The building consists of 3 wings, each 47 feet square, made up entirely of precast members surrounding a central unit of cast-in-place concrete. The framing in each floor required post-tensioning 2 beams made up of precast segments. STRESSTEEL Bars, 2 @ 1⅛" Ø and 3 @ 1¼" Ø furnished a force of 575,000 lbs. per beam.

These bars were threaded through holes preformed in the interlocking precast segments by workmen operating from a scaffold suspended from the crane. STRESSTEEL Bars were simply and quickly tensioned with electrically operated hydraulic jacks and then pressure grouted.

In addition to precast applications, imaginative engineers are using STRESSTEEL Bars as the effective solution to many other problems. These high strength alloy steel bars are available in sizes up to 1¼" Ø with recommended working stress up to 90,000 psi. Equipped with wedge or threaded anchors, STRESSTEEL Bars have been used for sheet piling ties in cofferdams, embedded ties for tainter gate trunnions, arch ties, buttress ties and many other unusual and special applications.

You will achieve superior results at substantial savings with STRESSTEEL because it is . . .

- High strength alloy steel
- Low in initial cost
- Low in labor cost
- Easy to tension

Are you working on a special anchorage, tie rod or foundation problem? STRESSTEEL'S high strength reinforcement, combined with the advantages of post-tensioned prestressing, may well be the optimum solution. Ask us.

Write for Technical Bulletin No. 2.

Member—Prestressed Concrete Institute

STRESSTEEL CORPORATION
221 Conyngham Ave. • Wilkes-Barre, Pa.
Sales Offices: Minneapolis and San Francisco

EQUIPMENT MATERIALS and METHODS

(continued)

Pioneer Industries, Inc., the towers, named "Diamond Truss," use aluminum alloy 6061-T6 extruded shapes and pipe and 5083 alloy plate supplied by Kaiser Aluminum & Chemical Sales, Inc.

For comparable loads and rigidity, the towers are at least 60% lighter than steel towers. Because of this light weight, most roofs can support the aluminum towers without additional structural reinforcement of the building. Also, since the towers are self-supporting, guys are not needed. —CE-14

Sulky Seat Aids Welders

SAFETY, CONVENIENCE AND EASE of adjustment are three noteworthy features of a new tubular steel "sulky" for welding operators on bridge girders and other overhead structures.

The telescopic sulky by the Lincoln Electric Co., comprises a simple pressed steel perforated seat protected by a 9-in. high circular rail of steel strapping. Support for the seat is welded steel scaffold tubing and it carries a curved tubular footrest. This entire assembly rides a tubular steel mast which is hung on a bracket straddling the top flange of the girder. The mast is punched at 12-in. intervals to permit the sulky to be pinned to it at any desired level for the most convenient welding position.

The "bosun chair" can be swung around the mast to any position for vertical, horizontal or overhead welding. In a seated position, the operator is more comfortable, can weld faster and becomes less tired. The unit can be set up in a few minutes by one man and can be adjusted for height in a comparable period. —CE-15

T-Chord Longspan Joist

A NEW RECORD LENGTH for Longspan steel joists has been established with the introduction of a 175-ft T-Chord Longspan Joist. According to Haven-Busch Co., the joist opens new horizons to architects in planning larger clearspan, column-free interiors. It is expected to be used primarily in construction of shopping centers, bowling alleys, warehouses and other structures requiring column-free floor areas of maximum width, and it meets all AISC specifications.

Its prime features include all web members designed for compression stresses, modern T-Chord construction, one-piece fabrication with matched fit splices, ASTM-A-7 steel with minimum thickness of $\frac{3}{16}$ in. and all welds performed by certified AWS weldors.—CE-16

HOW TO SAVE TIME AND MONEY

Use This NAYLOR Pipe and Coupling Combination

Where savings in time and labor are important, you'll like this combination of NAYLOR Spiralweld pipe and Wedgelock couplings.

Easier handling comes naturally with this light weight pipe. And the NAYLOR lockseamed-spiralwelded structure adds the strength and safety your job requires.

With the Wedgelock coupling, you not only save time in making connections, but also simplify the work involved since a hammer is the only tool required to connect or disconnect it.

For air, water or ventilating lines, it will pay you to consider this hard-working combination. Just ask for Bulletin No. 59.

The NAYLOR Wedgelock coupling makes a positive connection, securely anchored in standard weight grooved ends.

NAYLOR PIPE *Company*

1281 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

Pipe Line Holiday Detector

A PIPELINE HOLIDAY DETECTOR which provides constant voltage in any climate has been developed by Tinker & Rasor. Fully portable, the Model HP requires no generator, and makes use of a unique new electrical field device consisting of a double electrode or plastic coated saddle. This flexible pad is attached directly to the instrument carrier and creates a constant inspection voltage on the pipe line which is adjustable from 5 KV to 20,000.

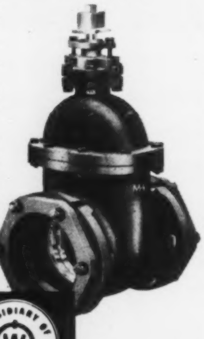
Weather or ground conditions will not affect successful operation of the Model HP and it will perform equally well on wet or dry coatings. Every inch of the pipe surface is traversed during inspection by spring electrodes, with snap-off connectors for passing over skids. **—CE-17**

As the Twig is Bent

To understand and appreciate the products and services of a 34-year-old industry, you need to know something of its background. Industrial growth and success do not just happen by accident in our American competitive free-enterprise system. "As the twig is bent, the tree's inclined." Therefore, this is the first of a series of institutional advertisements to illustrate how many years ago the M & H twig was bent to produce today's thriving industrial "tree" known as the M & H Valve and Fittings Company.

To begin with, M & H is an example of how civic spirit pays off. Anniston Chamber of Commerce and a group of Anniston business men in 1925 raised money by public subscription to buy used equipment to manufacture valves and fittings. The M & H plant was built and started production in 1926. In the following 5 years, the new Company gave little indication that within 25 years M & H would be one of the leading industries in its field.

How, when and why these highlights of M & H history occurred, may be a matter of interest today to water works engineers and public officials. It is the background in which M & H product-integrity is deeply rooted.



(No. 1 of a Series)

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH

New Scaffold

A NEW SCAFFOLD ESPECIALLY designed for working inside spheres and irregular shaped tanks, has been developed by Atlas Industrial Corp. The requirement for this type of scaffold is the installation of a uniform diameter length tubing from top to bottom. The balance of the equipment is entirely removable from within the tank and can be raised or lowered either by hand, electrically or by air.

The longitudinal sections of the work platform are so designed as to be telescopic in nature as it approaches the top or bottom sphere. The entire assembly can be rotated around its axis and accessibility is attained to every portion of the entire sphere or tank.

This newly designed scaffold can be fabricated for capacity ranging up to 600 lb at the extreme end depending upon requirements. It is of all-welded steel construction, relatively light in weight and can be installed in the opening by two men. Guard rails are demountable and equipment is primarily designed for ease of manipulation. **—CE-18**

Engine and Tracer Lathe

DESIGNED TO HANDLE HEAVY WORK, up to forty tons, the Maxi-Swing Lathe, manufactured by The American Tool Works Co., will make precision cuts to ¾-in. depth. It is available in four sizes with swings from 74 to 108 in. over the bed, which is 56 in. wide with four hardened and ground replaceable Vee-ways. The tracer lathe is completely equipped with carriage mounted power unit and motor, all hoses and fittings, hydraulic tracer valve, angle tracer slide with hydraulic actuating cylinder, periscope-type precision optical viewer, template holder brackets and adjustable supports for flat templates.

Internal geared face plate drive, pendant controlled operation including apron feed clutches, 7½-in. dia tail stock spindle, and traveling operator platform, are standard equipment for either engine or tracer lathe. **—CE-19**

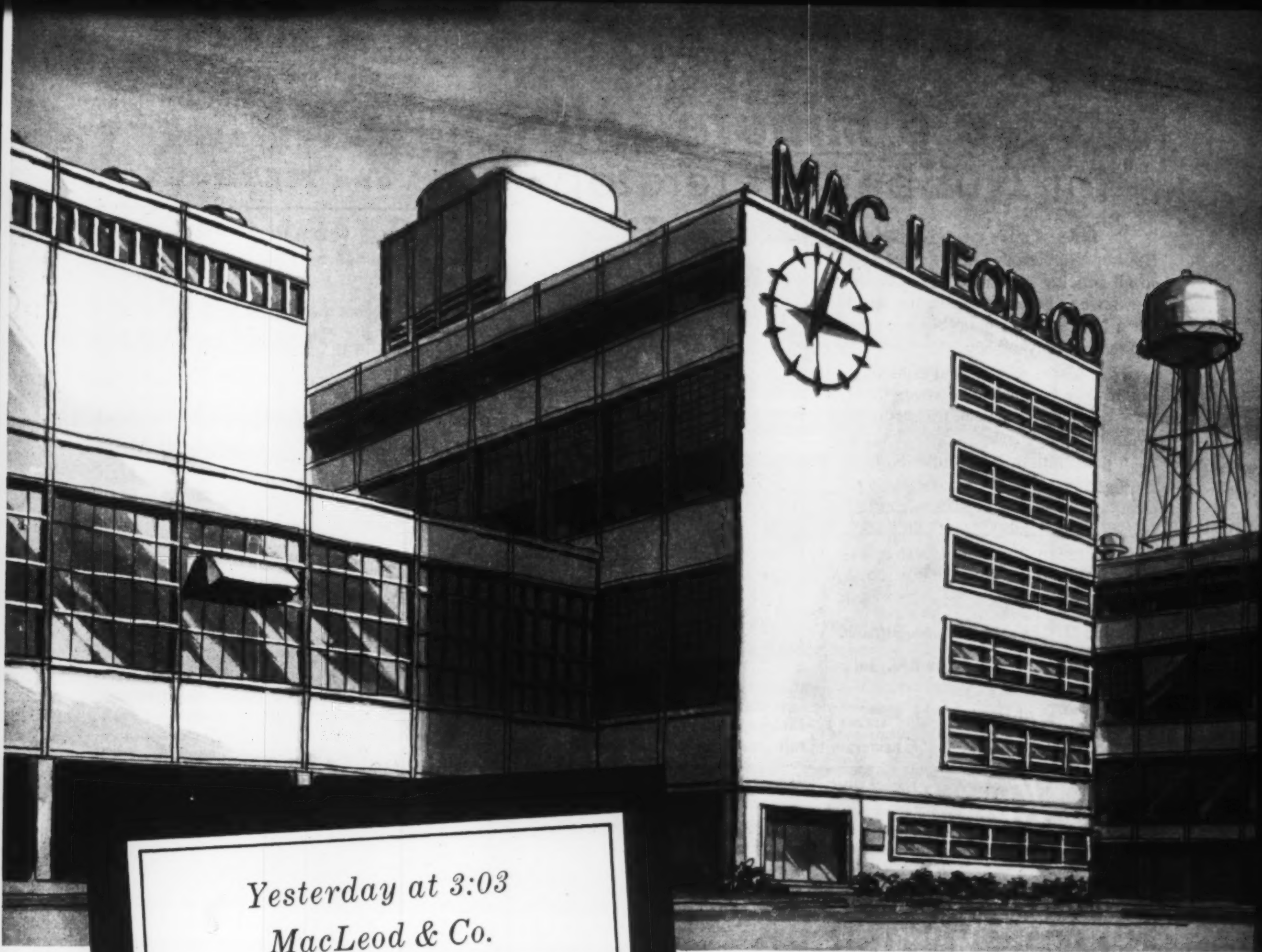
Giant Rims

GIANT 39-IN. DIA RIMS have been developed by the Firestone Tire & Rubber Co. for high load capacity construction equipment which is now in design stages. The rim assembly weighs 829 lb and is made of hot rolled steel.

A result of the latest step taken by equipment manufacturers to increase pay load of dirt-moving rigs, the rim and its tire have a 3,750-lb greater load capacity than the previously standard tire and rim of 33-in. dia.

A unique welding process assures equal penetration for maximum strength. Rim

(Continued on page 150)



Yesterday at 3:03
MacLeod & Co.

Went out of business

(it could happen to you...
TODAY!)

At 3:03 p.m. yesterday this clock stopped.

So did plant elevators . . . one of them mid-floors, with Mac Leod in it. Lights went out . . . computers, tabulators and typewriters "died" . . . critical plant equipment stood useless. Pumps handling continuous-flow processing coughed to a halt . . . and in the laboratories, a crucial experiment requiring weeks of costly preparation was hopelessly sabotaged.

Without the "safety valve" of *adequate* power-generating standby diesel units, thousands of dollars worth of water-cooled processing equipment was quickly "cooked" to scrap iron by the crippling paralysis of power failure.

Seconds before, a catastrophe could have been avoided . . . if a Fairbanks-Morse Opposed-Piston diesel had been on hand, ready to pay for itself within the first few fleeting minutes!

When did you last review your standby power facilities? Yesterday? Eighteen months ago?

When emergency threatens . . . be it electrical storms, high winds, floods, drouth, heavy snows or equipment breakdown . . . you want *adequate* standby power equipment. And you want *the best.*

That, of course, means Fairbanks-Morse, pioneers of diesel building in America. No other manufacturer produces so great a variety of diesel engines for *all* services and purposes, from one-cylinder and five hp to 12-cylinders, 4200 hp . . . and *matching* generators, alternators and generator sets.

Get the facts why F-M two-cycle, Opposed-Piston diesel power . . . turbo-charged or otherwise . . . is unsurpassed for compactness, dependability and fuel savings. Drop a line today to: Fairbanks, Morse & Co., Diesel Division, Beloit, Wisconsin.

Fairbanks, Morse
DIESEL DIVISION

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Now... a 6 minute splice for Rubber Waterstop

To splice Gates new Kwik-Seal Rubber Waterstop, all you need is a small splicing kit and simple clamping device. This eliminates the need for a field vulcanizer, molded parts, a power supply or heat.

The Gates Kwik-Seal splice is chemically bonded. The strength of the bond often exceeds the strength even of the rubber – far stronger than government requirements. *One man makes this strong, permanent splice in just 6 minutes – 5 times faster than with former methods!*

As a result, this new Gates splicing method cuts your labor costs and speeds the job.

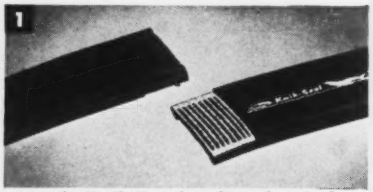
WRITE FOR CATALOG and splicing demonstration.

The Gates Rubber Co. Sales Div., Inc.
Denver 17, Colorado

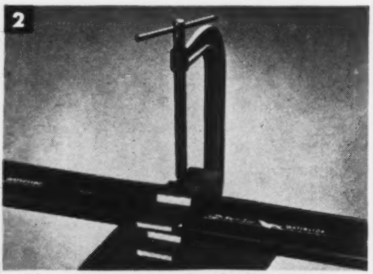
Gates Rubber of Canada Ltd.
Brantford, Ontario

TPA 977-A

SEE OUR CATALOG IN SWEET'S

1


Apply Kwik-Kem bonding chemical to prepared surface.

2


Clamp Waterstop firmly for 5 to 6 minutes... and it's spliced.

Gates

Gates *Kwik-Seal* Waterstop

ENGINEERING EDUCATION CONFERENCE

I would like to attend the Conference on Civil Engineering Education to be held at the University of Michigan, July 6 to 8, 1960. Will you please send me the appropriate registration material? I (have, have not) been designated as an official delegate to the conference.

Mail to:
Dr. Bruce Johnston
Chairman, Committee on Local Arrangements
University of Michigan, Ann Arbor, Michigan

Name ....
(Please print)
Street ....
City ....Zone..........State..................
Representing..If official delegate, who designated you? ....

EQUIPMENT MATERIALS and METHODS

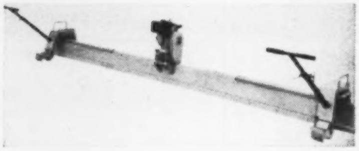
(continued)

components are joined by balanced submerged arc welds on both the inside and outside of the rim. —CE-20

Vibrating Screed

Useful in concreting floors, walks, airport aprons, bridge decks, ramps and streets, this Vibrating Screed from Maginiss Power Tool Co. is said to produce uniform consolidation of concrete while striking off a smooth surface. Low slump mixes, too stiff for manual screeding, are claimed to be easily handled by the machine.

The assembly consists of a vibrating unit and a pair of end dollies, which can be mounted on a 2- or 3-in. by 10-in. wood beam up to 36 ft long. An 8-ft width adjustment of the dollies (4 ft on each end) is provided. Thus, when mounted on a 16-ft beam, it is possible to screed slabs of any width between 8 and 16 ft. The telescoping pull handles are adjustable for height.



Low Slump Mixes Easily Handled

The standard power unit has a 2½-hp, 4-cycle air-cooled gasoline engine with two enclosed "V" belts driving the eccentric, which runs on heavy-duty ball bearings sealed against dirt and moisture. Spring mountings isolate the engine from the vibrator.

Vibration frequency on engine driven units is variable (3,600 to 8,000 vpm) which allows selection of a frequency best suited to each mix; this is accomplished by an engine speed control conveniently located. —CE-21

New Shovel

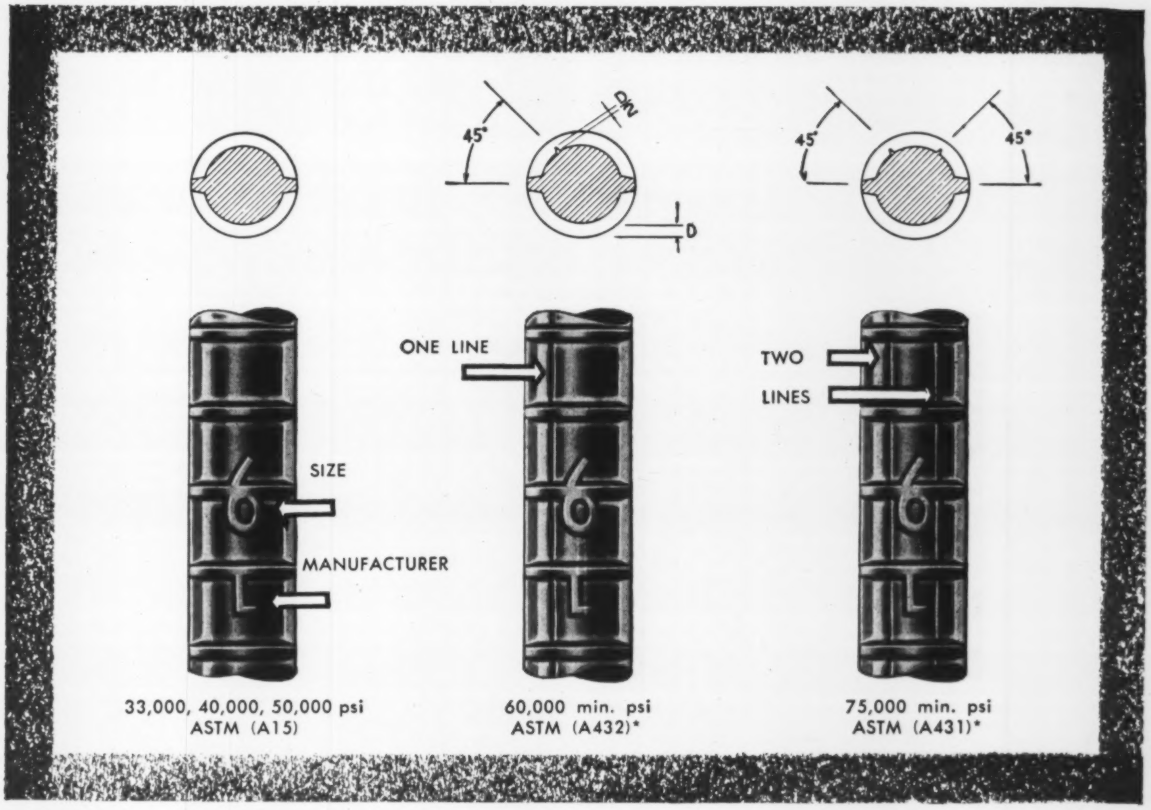
The new Model 1220, ¾-yd shovel, convertible to crane, dragline, trenchoe, clamshell and magnet attachments, has been announced by Unit Crane & Shovel Corp.

Fifty per cent more braking ability is claimed for the shovel, which is equipped with a new 17¾-in. dia. by 5-in. wide

(Continued on page 152)

NOW...

Every LACLEDE Multi-rib Reinforcing Bar is Marked to Show SIZE and STRENGTH...



33,000, 40,000, 50,000 psi
ASTM (A15)

60,000 min. psi
ASTM (A432)*

75,000 min. psi
ASTM (A431)*

Standard high strength steels* permitting greater economy and efficiency in reinforced concrete design under the provisions of the new A.C.I. codes must be **identified.** Recognizing this need, each Laclede Multi-rib reinforcing bar can now be completely identified as to size, strength and origin through a new rolled-in marking system. This assures the designer, contractor, and code writer that the proper grade of reinforcement is used on the job.

Demand these new time-saving Laclede bars for your next construction job.

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LACLEDE STEEL COMPANY

SAINT LOUIS, MISSOURI ◆ Producers of Steel for Industry and Construction

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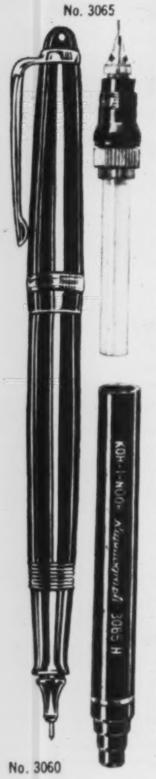
PRECISION MATCHED INSTRUMENTS

Koh-I-Noor offers draftsmen an important new dimension in a comprehensive line of instruments and accessories meticulously matched to provide new high levels of professional performance, efficiency and convenience.



NOW...
TWO KOH-I-NOOR
RAPIDOGRAPH
TECHNICAL
FOUNTAIN PENS

In 7 "color-coded" precision line widths: 00, 0, 1, 2, 2½, 3, 4. Uses India (or regular) ink for ruling, lettering, tracing or writing with equal facility.

MODEL NO. 3065: A new model with 7 interchangeable drawing point sections, each color-coded to indicate a different line width. Best buy for the professional who requires frequent change of line widths. Each drawing point section complete with airtight refillable ink cartridge. Interchange is accomplished quickly, cleanly. Comes in handy desk top container.

MODEL NO. 3060: The regular Koh-I-Noor Rapidograph "Technical" Fountain Pen with self-contained automatic filling system, and pocket clip is a standard drafting room tool.

Two Koh-I-Noor products designed to work together . . . for greater efficiency!

KOH-I-NOOR
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KOH-I-NOOR
ADAPTO-CLUTCH LEAD HOLDER
Non-slip, turn-proof clutch takes full range of Koh-I-Noor lead.

KOH-I-NOOR
EJECTOMATIC LEAD DISPENSER
Automatically feeds lead to holder without need to touch lead. Transparent container permits constant inventory check on lead supply. In 17 degrees. Widest choice of containers with 2, 6 and 12 leads.

Write for catalog

KOH-I-NOOR
PENCIL COMPANY, INCORPORATED
BLOOMSBURY, NEW JERSEY

EQUIPMENT MATERIALS and METHODS

(continued)

brake; housings are completely ventilated for maximum efficiency.

Among the many features of the 1220 are the following: one piece cast gear case enclosing all gears and shafts which operate in a constant bath lubricant; straight-in-line mounting of gas or diesel engines with main machinery for immediate power action; full vision safety cab; six independently adjusted hook rollers; and rugged all-welded constructed turntable. —CE-22

Dry, Dustless Drilling Method

A FASTER, CLEANER, LOWER-COST method of dry-drilling reinforced concrete has been developed by New England Carbide Tool Co. This new "Method A," as it is called, is ideal for use in areas where dust and noise would be prohibitive, such as in hospitals, hotels, offices, institutions, food-processing and industrial plants.

The new method incorporates the company's Cyclo-core Bits, Dust Exhaust Swivel, Power Unit, and Dust Collector. This unique method of removing the dust and steel cuttings from the hole reduces heat, friction and noise to an absolute minimum. The full power of the drilling equipment can now be applied to the bit, resulting in a faster rate of penetration and longer bit life. With the faster cutting rate, labor costs are drastically reduced. —CE-23

Resilient Seated Butterfly Valve

FOR FLOW APPLICATIONS where positive, drop-tight shut off and/or resistance to corrosion are important requisites, the new Resilient Seated Butterfly Valve, manufactured by W. S. Rockwell Co., offers many advantages.

This valve is much smaller in overall dimensions and weighs but a small fraction of that of a gate valve. For example, an 8-in. butterfly valve is 2½ in. face-to-face, 8⅜ in. from center line of pipe to top of valve and weighs 37.5 lb, whereas an equivalent 150-lb designed gate valve is 11½ in. face-to-face, 29½ in. from center line to top and weighs 320 lb.

In the new valve, the disc travels from full open to full closed position in only a quarter of a revolution, with equalized pressure on the disc. There are no mating metal surfaces to corrode or bind, so that operation is always simple, positive, and fast. The streamlined shape of the disc enhances straight through flow of the fluid without changes in direction. There are no voids or cavities in the valve body to cause eddy currents or fouling with foreign matter. Pressure drop is extremely low. —CE-24

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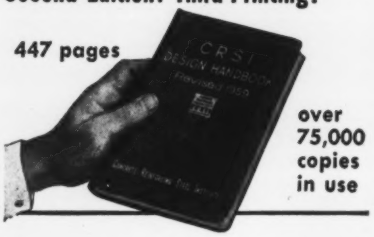

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AUTOMATIC
Sewage Regulator

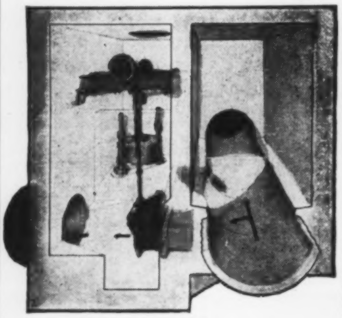

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request

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airports

industrial plants

WHY ADVERTISING IN CIVIL ENGINEERING STIMULATES SALES IN CONSTRUCTION MARKETS

In the construction industry, four major groups account for nearly all product buying and specifying:

CONSULTANTS ■ CONTRACTORS ■ PUBLIC WORKS ■ OWNERS

Civil engineers occupy key positions in each group. Not only are they responsible for design, construction, operation and maintenance "in the field"... civil engineers are also a primary influence "behind the desk," in charge of management.

As a result of this wide responsibility, civil engineers largely control the specification and purchase of construction equipment, materials and services.

The only magazine edited exclusively to serve the technical, business and professional needs of this select audience is CIVIL ENGINEERING ... official publication of the American Society of Civil Engineers.

Year after year, its circulation has increased with construction activity and the growth of the civil engineering profession. Editorially CIVIL ENGINEERING serves all areas of construction and all civil engineering interests – making it truly The Magazine of Engineered Construction.

Basic data on the civil engineer's role in different construction industry groups is being furnished by A.S.C.E. Mail Forum surveys. For example, the most recent study (of consulting engineers) revealed these facts:

- CIVIL ENGINEERING's consultant readers own or work for firms that concentrate almost entirely on *engineered construction* projects...with their work divided among the various types of construction as follows:

Airports	3.8%	Military sites	3.9%
Bridges	7.6	Pipe lines	4.6
Buildings, commercial & residential	17.9	Rivers & harbors	1.6
Dams	2.7	Waste treatment	10.9
Highways & streets	14.6	Water supply	10.1
Industrial plants	9.1	Miscellaneous	13.2

- the average annual cost of all the equipment and materials specified by each of the 290 firms reported is well over $6 million.
- 90% of the readers influence the purchase and the specification of construction materials, installed equipment and office equipment.
- their titles and functions are proof of a high degree of authority and a wide area of buying influence within their firms.

In CIVIL ENGINEERING, *advertisers reach top quality consultants concerned only with construction. This is the core of your consulting engineer market ... the men who specify your products!*

And remember... whether your product is specified and purchased through consultants, contractors, architects, owners, public works officials (or any combination of these groups) you get the *most effective, most economical* coverage of civil engineers by advertising in CIVIL ENGINEERING Magazine.

Quality circulation guarantees that your product message will be concentrated on men who make the decisions that lead to purchases! ... which is why we say, "advertising in CIVIL ENGINEERING stimulates sales in construction markets."

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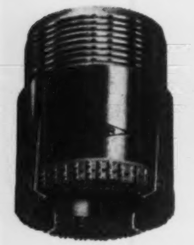

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Edo Model 255C Survey Depth Recorder gives permanent bottom readings on over-lapping range scales.

EDO, PIONEER IN THE DESIGN AND DEVELOPMENT of sonar equipments for military and commercial use, manufactures three outstanding units to satisfy every hydrographic requirement.

EDO MODEL 255C SURVEY DEPTH RECORDER. Portable equipment for permanent or temporary installation aboard vessels of every size. Extremely accurate and easy to operate. Model 255C is the ideal recorder for depth, penetration and general underwater survey in water depths from 1½ feet to 230 fathoms. Weighs only 55 lbs.

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EDO MODEL 185 DEEP DEPTH SOUNDER. AN/UQN-1D. Developed by Edo for the U.S. Navy and now available commercially. Model 185 gives clear indication of depth from 0 to 6,000 fathoms. CRT indicator gives depth readings on two scales; recorder charts on three scales. No comparable equipment has ever before been produced in such quantity.

For technical details on these fine Edo hydrographic units, write to Dept. V-3.

Edo CORPORATION, College Point, L. I., N. Y.

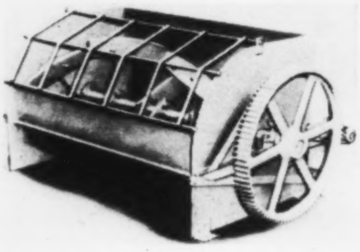
EQUIPMENT MATERIALS and METHODS

(continued)

New Cement Mixers

Ingenious innovations, based on time-tested engineering principles, have resulted in far greater durability and lower costs in a new line of standard cement mixers from General Engines Co.

Mixer bowls are provided with heavy liners, which are easily renewable when worn. In place of ribboned blades, paddles are installed in the new mixers. For durability, these are easily adjustable; they can be set to give the best and fastest mixing with minimum power and replacement costs only half as much as that of ribboned blades. To cut costs further, the mixers feature a mixer bowl which is of all-steel plate construction, rolled and welded to form a solid, one-piece unit. Positive locking is assured by a heavy I-beam welded to the door; the discharge door can be operated from either the right or left hand side of the mixer. Dry batch construction mixers are available in sizes from 15 to 60 cu ft capacity. —CE-25

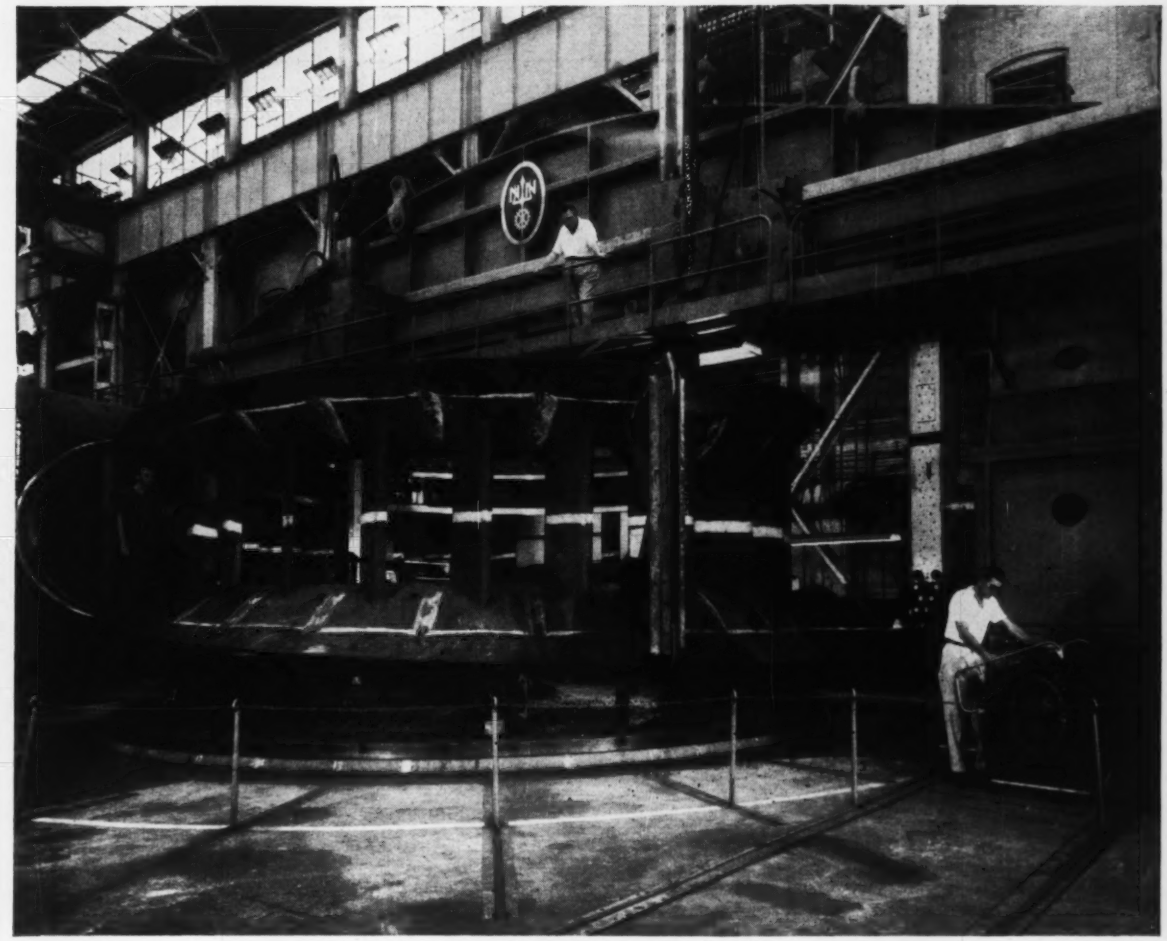


Lower Costs

"Drawing Chief" Desk

Designed to serve as a standard executive desk and drawing table for home or office, the "Drawing Chief" desk is available from Densmore Calculator Co. in different styles, desk top sizes, electrical outlets, locks and drawing board pencil trough.

The drawing board is concealed under the desk top and elevated into posture chair height by a raising mechanism when the desk top is opened. When the desk top is closed the drawing board is automatically lowered in a flat plain into a well which has sufficient clearance between the drawing board and desk top for permanent mounting of drafting machine. This clearance also eliminates the necessity of removing tools or reference books from the drawing board. Adequate storage facilities are provided for drawings, drawing paper, reference books, catalogues, files and tools. —CE-26



42 ft. boring mill-rough cuts a stay ring for one of the world's most powerful hydraulic turbines.

Newport News builds six king-size turbines for Niagara Power Project

These skilled Newport News machinists are milling a stay ring for one of six 200,000 hp. Francis-type hydraulic turbines. Before they're finished, they'll turn out five more turbines—the world's most powerful—for the Lewiston Power Plant of the Niagara Project.

Newport News has not only the men, but the facilities to take a job like this in its stride . . . your job, too. For example, the 42 ft. boring mill pictured above was designed and built at Newport News.

The large engineering and technical staffs, acres of iron, brass and steel foundries, five huge machine shops, and additional specialized equipment make Newport News a leader in the production of hydraulic turbines, valves, gates, penstocks, and other water power equipment you need.

Consult Newport News engineers on preliminary design recommendations at no obligation.

Engineers . . . Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

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EQUIPMENT, MATERIALS and METHODS

(continued)

Semi-Automatic Tongs

THE USE OF SEMI-AUTOMATIC tongs is saving time and lessening the possibility of accidents, during the construction of the New Cumberland Dam, at Stratton, Ohio. Made by Heppenstall Co., the tongs are used to pull sheet piles, each 60 ft long and 16 in. wide, that had been driven deep into the river bed to form a cofferdam, which was erected to hold back the waters of the Ohio River while men worked on a section of the dam. Powerful skin friction must be overcome to remove the piles, which are then used to form a cofferdam for another section.

The piles are normally pulled with a steam-powered pile extractor, but in the past this usually has required that someone run the pin of a clevis through a hole in the top of each pile, a time-consuming and occasionally hazardous job.

At the New Cumberland Dam site, however, Dravo Corp., which is building the dam for the U.S. Army Corps of Engineers, replaced the clevis with an improved form of sheet piling tongs. Lowered over a pile with their jaws locked open, so that the jaws slide readily over the center web of a pile, the tongs grip it firmly, with no need for anyone to make a manual adjustment. When the operator allows a bit of slack in the line, a latch is disengaged from its retaining pin, allowing the jaws to close. As the tongs are raised, the pile is pulled without difficulty. —CE-27

Chain Sleeve-Clamp

MANUFACTURED BY Black Brothers Co., Inc., a new easily-mounted chain sleeve-clamp for attaching rubber sleeves at hydraulic pipe line joints has extensive applications in dredging operations, hydraulic mining of sand and gravel and similar installations.

The clamp consists of a triangularly-shaped head cast of certified malleable iron, a 1-in. high carbon steel screw, a swivel handle, and an electric-welded chain welded to one end of the screw and hooked to the head of the other end; the hook is a steel forging.

A few turns of the swiveled handle draws up the screw and chain, applying adequate pressure to secure the rubber sleeve. —CE-28

Mobile Hydraulic Hammer

A NEW SIDE-ACTION MOBILE hydraulic hammer is now being manufactured by Arrow Mfg. Co. With Model 130-AS, the operator has a 7-ft working width when leads are vertical and 8 ft when angled.

Designed to work close to piers, abutments and footings, it can work from side to side across the front of the machine, and also forward or in reverse, breaking concrete highways, concrete slabs, curb and gutter, bridge decking, flooring in structures and for street openings.

Control of the side action is hydraulic. The hammer can be shifted rapidly from side to side. Lift of the 1000-lb hammer weight can be controlled from inches up to 9 ft. Hammer stroke control can be set on automatic to deliver blows of uniform impact at a uniform rate, or the hammer can be controlled manually. Other hydraulic controls tilt the tower forward or backward or at an angle or fold it back, reducing the height of the machine from 13 ft 11 in. to 6 ft 10 in. for going through doorways or for travel on the highway. —CE-29

WALKER PROCESS SPARJAIR COMPLETE SEWAGE TREATMENT PLANTS

Designs for all Developments and Land Planning Projects

Hampton Pk. (Hsg. Devel.), Ill.—1 mgd tot. cap.

TRAILER PARKS
Finn Trailer Ct., Ill. (365 units)—45,500 gpd.

SHOPPING CENTERS
Hillcrest Shpg. Ctr., Joliet, Ill.—50,000 gpd.

Sparjair units overcome previous objections to locating a plant near residences, shopping areas, schools, etc. Its new but proven principle of Contact Stabilization aerates and thoroughly oxidizes all odor producing wastes.

Nested design provides complete treatment equal to large municipal plants.

1. Permits development of outlying, low cost land.
2. Capacities from 50 to 5000 population equivalent.
3. Eliminates septic tanks and drain fields.
4. Virtually automatic—Simple operation.
5. Approved by Health Authorities.
6. Odor free — no septic or stale operations.

Details and layouts are available to Consulting Engineers and their Architects, concerned with the design of package sewage and water treatment plants. Write factory at P. O. Box 266, Aurora, Ill. for complete information.

Walker Process also offers CLARIPURE Package Water Purification Plants—pre-designed capacities from 50 to 600 gpm.

WALKER PROCESS EQUIPMENT INC. FACTORY • ENGINEERING OFFICES LABORATORIES AURORA, ILLINOIS

EQUIPMENT MATERIALS and METHODS

(continued)

Flexible Steel Form

A NEW FLEXIBLE STEEL FORM for pouring uniform curves in concrete can be preset to hold any desired contour. Manufactured by Binghampton Metal Forms Inc., Radi-Lok shortens set-up time, minimizes stripping effort, and practically eliminates surface finishing, thereby cutting labor costs. The steel form produces smooth attractive facings for both inside and outside curves on low walls, sidewalks, curbs and gutters. It is light weight but strong, withstanding constant hard use and pouring stresses.

Radi-Lok is simple to use; set the stakes, select the curve by adjusting the band, and tighten the lock nuts. After pouring, the form can be repositioned to repeat the same curve without any other adjustments. Rigidity is built in: six giant ledges and six range brackets clamp and brace each form against the supporting stakes. —CE-30

Electricweld Pipe

MANUFACTURED BY Jones & Laughlin Steel Corp., an electricweld pipe made of light-weight galvanized steel and equipped with a quick coupling is reducing the installation cost 66% on temporary gas and water lines at oil drilling rigs.

Lightness and the pipe's extremely fast, easy coupling system sharply reduce the labor and time required to lay temporary gas and water lines. Only two men are needed to string and couple the pipe which is made in 30-ft lengths.

Fitted with McDowell Manufacturing Company's Fast-Line Couplings, pipe lengths are joined 12 times faster than standard threaded and coupled pipe. Leak-proof joints are made up in a matter of 15 to 30 sec, without tools, merely by hand-tightening a coupling lock nut. An oil and water resistant sealing gasket, seated inside the coupling, assures a leak-proof joint. —CE-31

New Bolt Design

A NEW DESIGN HIGH strength bolt with larger head and shorter thread length will substantially increase present advantage of high strength bolts over other types of structural fasteners, according to Russell, Burdsall & Ward Bolt & Nut Co.

Savings up to 40% in bearing-type connections over present high strength bolts are made possible by the new head and thread design, the company's engineers report. The larger bearing area under the head permits use of only one washer per bolt; it can be used under either bolt head

(Continued on page 158)

Specify
MARACONCRETE...
FOR HIGHER STRENGTH..
GREATER DURABILITY, MINIMUM SHRINKAGE
AND LOWER CONCRETE COSTS.

Neuropsychiatric Institute, University of California at Los Angeles, Westwood, California.

Concrete Pipe Manufactured by F. Hurlbut Co., Green Bay, Wisconsin.

Reinforced Concrete Beams Manufactured by F. Hurlbut Co., Green Bay, Wisconsin.

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Mission Boulevard Pre-Stressed California State Highway Bridge, Riverside, California.

Los Angeles International Airport, Complex 1, East-West Runways, Los Angeles, California.

MARACONCRETE CONTAINS MARACON® WATER-REDUCING ADMIXTURES FOR CONCRETE

Maraconcrete is being used in the construction of reservoirs, bridges, runways, and buildings . . . in the manufacture of reinforced concrete beams and pre-cast structures, in pipe and drain tile.

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V-60

EQUIPMENT, MATERIALS and METHODS

(continued)

or nut, whichever is rotated in tightening. Shorter thread length prevents the shear plane of the connection passing through the threaded portion of the bolt. Increasing the shear area of the bolt increases the allowable working shear stresses so that one-third fewer bolts are needed in bearing-type connections which form the majority of structural joints. The large head bolt has the same across-flats dimensions as the presently used heavy nut, eliminating the requirement for the two different wrench openings presently needed. —CE-32

Concrete Vibrator

The production of a new revolutionary internal concrete vibrator, Model HIV-1, is announced by Wacker Corp. It operates only on 50 volts for safe handling by operators on wet ground. High frequency, 180 cycle vibrator, squirrel cage motor-in-head operates at 10,000 rpm under load, even on high type concrete.

A Kohler generator set with 4 cycle gas engine, capable of handling two 2¼-in. vibrating heads, powers the HIV-1. Two single phase, DC, 115 volt, 1000 watts outlets are provided on the generator set to power auxiliary equipment such as lights, drills and saws. —CE-33

Wire Rope Slings

Offering greater safety and strength than heretofore, a new series of Double Green Stripe, VHS Strand-Laid Wire Rope Slings have been announced by American Chain & Cable Co., Inc.

Said to be the strongest slings in the world, they are fabricated from a superior grade of uniform analysis, high carbon steel and processed in an improved manner to give the characteristics needed in a heavy-duty wire rope. Size for size, these slings are at least 15% stronger than the highest normal grades of Improved Plow Steel slings, the manufacturer states.

All slings are equipped with Duoloc wire rope endings, which do not damage the wire rope nor unbalance and destroy the rope structure like a hand splice or compression ending. Duoloc permits the use of preformed wire ropes with independent wire rope center, retards fatigue, absorbs vibration, and is locked for the full life of the wire rope. —CE-34

Rubber Asphalt Joint Sealer

Offering a fast, economical way to seal out moisture, drafts, insects and dust, United States Chemical Company's Join Seal bonds well to concrete, steel, masonry and other surfaces and remains flexible over a long period of time. Because it blends rubber and asphalt, it has a flexible quality which makes it possible for it to stretch as joints expand, and to withstand moisture. This flexibility will make it last many seasons longer than materials which have a tendency to shrink and harden with age.

Join Seal is being used for a variety of purposes by both the do-it-yourself fan and skilled maintenance and construction men. Among the many uses which have been favorably reported are: Sealing foundation cracks, sealing around pipes which run through walls, filling cracks in driveways, sealing metal buildings, repairing roofs, gutters and roof parts. —CE-35

Waterproof and Maintenance Coatings

Some of the waterproof and maintenance coatings available from Protex-A-Cote, Inc., include: Porselon, an epoxy surface coating insoluble and inconvertible in practically every organic and in-

(Continued on page 159)

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EQUIPMENT MATERIALS and METHODS

(continued)

organic solvent, agent and reagent. It is designed to provide all elements of protection and decoration and may be used as an all-purpose maintenance coating on machinery, conveyors, structural steel, tank exteriors, walls, piping and similar places where metal, concrete or wooden surfaces are exposed to corrosive fumes or spillage.

Tac TE-106 Concrete Adhesive is used for bonding of old-to-old and new-to-old concrete; for welding of pre-cast materials, brick traffic markers, block pavement, to concrete, bituminous and other surfaces; and for overlays, remedial patching and anti-skid surfacing on all types of floors and slab. —CE-36

Elevating Grader

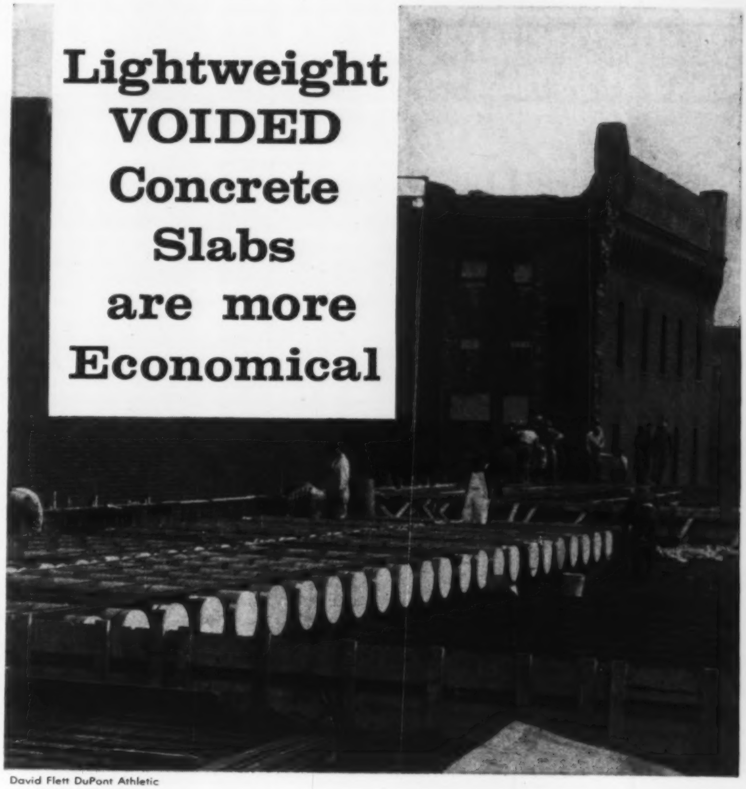
An all-new, high production elevating grader with a loading capacity up to 900 cu yd per hr, was recently introduced by Ulrich Manufacturing Co. Called the Domor Model 64, the machine features a 48-in. belt, 36-in. disc, and higher belt speed, and is designed to match the larger production capacity of the 150-hp Caterpillar No. 14 Motor Grader. Added to the Model 64's greater loading capacity are several exclusive design innovations to reduce operating costs and installation time.

An entirely new mechanical arrangement prevents accidentally damaging the loading belt with the plow disc during operations. This is accomplished by a pivoted connection between the lower end of the conveyor and the disc beam which always keeps the disc at a predetermined distance from the belt. The hazard of accidental belt cutting by the disc has been completely eliminated. —CE-37

Rock Drill

Designated as model S-30, this light-duty rock drill in the 45-lb class is said by Davey Compressor Co. to combine excellent drilling performance with extremely low maintenance cost. Because of its high output working capacity, the S-30 can be employed for drilling both primary and secondary blast holes; it can be used with an air leg if desired.

The drill has a 3-way throttle control—on, off, blow and is available in 3 types, which are blower, blast and wet. Also, alternate rotation speeds are available. Involute splines give longer life to rifle and shock nuts. The honed cylinder bore contributes to long, efficient service. A patented lubrication system assures automatic oiling of every working part. —CE-38



Lightweight VOIDED Concrete Slabs are more Economical

David Flett DuPont Athletic Center, Massachusetts Institute of Technology, Cambridge, Mass. Architects: Anderson Beckwith and Haible. Builders: George A. Fuller Co. Photo: Shaw Studios/Boston

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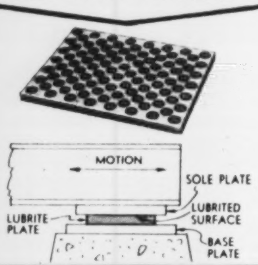

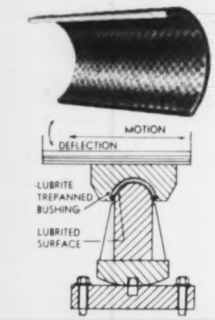

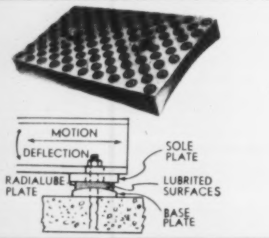

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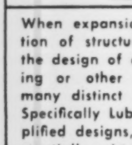

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Literature Available

CHEMICAL MIXTURES—Recognizing the need for a publication which would include much of the basic data on the use and storage of chemical mixtures and procedures for mixing, Calcium Chloride Institute has published a booklet entitled "Calcium Chloride and Salt Mixtures." The 24-page, illustrated brochure includes sections on benefits of using mixtures, when and where to use mixtures, how to use them, and significant results. The recommendations are designed to aid engineers considering maintenance procedures which will insure bare pavement. Data and methods presented are those which, through laboratory and field experience, have been found most satisfactory. **—CE-39**

SLUDGE COLLECTORS—A dual line of "normal duty" and "heavy duty" Streamline Sludge Collectors are now cataloged in Bulletin No. 6751 from Yeomans Brothers Co. Details on the application of these two lines will be helpful to engineers who are designing for either sewage treatment plants or industrial waste installations. Sectional drawings show typical layouts for primary and final settling tanks. Information plus drawings are included on modifications required to convert the sludge collectors into cross collectors for multiple tanks, and to mechanical skimmers for industrial wastes. **—CE-40**

SYSTEMS ENGINEERING DIVISION—A facility offering unique capabilities in image interpretation, terrain simulation, and aerial mapping systems is described in a 16-page report from Aero Service Corp. This Systems Engineering Division has been established to aid government agencies and prime contractors now working on satellite reconnaissance, aerial intelligence, and other space-age projects. It is equipped and staffed to produce earth simulators (relief models and global models), training devices (information input for flight simulators for pilot training), and data handling and analysis systems. **—CE-41**

SUBDIVISION COMPUTING SERVICE—Literature is available on the Subdivision Computing Service provided by Technical Advisors, Inc., and supervised by land surveyors and registered professional engineers skilled in electronic computing. Working from a preliminary plan of the subdivision, a mathematically-closed boundary survey and the lot specifications, the firm provides an accurate large-scale drawing of the subdivision, complete with all data for platting and staking. The service is available to any area that can be reached by mail, and the work is normally completed in 7 days. A typical subdivision drawing and computed data are also included. **—CE-42**

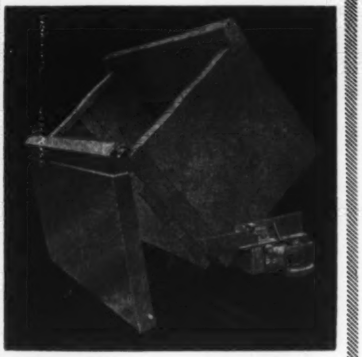
THREADED FASTENERS—A 32-page Design Manual No. 5930 published by Elastic Stop Nut Corporation of America illustrates the Equa-Stress modified UNF-3 thread form which, installed in a new series of Elastic Stop nuts, will at least double the fatigue endurance of a standard high tensile bolt. It includes 17 pages of findings related to the basic nature and causes of fastener fatigue; six detailed drawings of the new Double/Durability self-locking nuts; and applicable fatigue performance test results. **—CE-43**

HAND TRAVELING BRIDGE CRANES—A comprehensive and information-packed 4-page folder, Bulletin DH-468-C, describing the Type B-9 Wright Top Running, Single Bridge, Hand Traveling Cranes has been issued by Wright Hoist Div., American Chain & Cable Co., Inc. These cranes, available in capacities of 1 to 10 tons and in spans up to 50 ft in length, when combined with the manufacturer's hand or electric hoists will provide excellent installations where spotting of loads are more important than fast travel speeds. **—CE-44**

NUCLEAR PIPING—Entitled "Critical Piping for the Nuclear Age," Bulletin 60-A shows operations at the Midwest Piping Company's manufacturing and fabrication plants during production of welding fittings and fabricated assemblies for nuclear installations. Special emphasis is given to the welding techniques and quality control required for piping of such a critical nature. Also shown are nuclear piping installations erected by the company's field construction department. **—CE-45**

CURB AND GUTTER MACHINE—Literature is offered by Power Curbers, Inc. on the Smith-Field Automatic Curb and Gutter Machine, which operates on an entirely new principle by laying integral curb and gutter without forms and with a minimum of hand finishing. Illustrations and specifications are included. Information is also available on the Stephens-Canfield Automatic Curber, which extrudes compacted bituminous concrete or Portland Cement concrete curbs within 1 in. of obstructions, up or down hills and around radii. **—CE-46**

BELT CONVEYOR IDLERS—Bulletin 171, a 48-page engineering and product information booklet on belt conveyor idlers from Hewitt-Robinson, Inc., illustrates and describes the basic types of idlers used in all types of service—troughing, impact feeder, return trainer, feeding and picking, live shaft flat belt impact, wire rope, and rubber spiral idlers. Included are details of construction, comparison of 10 competitive designs, selection, procedure and examples, engineering tables, dimensions and specifications. **—CE-47**



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FREE Bulletin No. 18-b shows car details; No. 22 illustrates Automatic Coupler.

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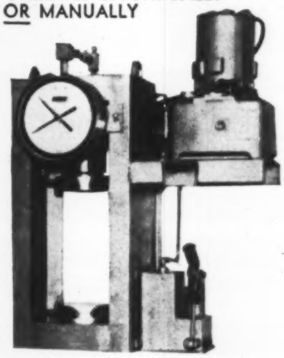

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Literature Available

Steel Products—This 28-page brochure from The Colorado Fuel & Iron Corp. "blueprints" the principal steel components, tools and materials that the company manufactures for the construction industry. Some of the tools described include grader blades and cutting edges, grinding rods and wire rope and slings. Construction materials include fabricated steel plate structurals, nails and staples, reinforcing bars and tie wire. —CE-48

Hydro Pumpcrete—One of the machines described in this product catalog by Seiwa Machinery Co. Ltd. is the Hydro Pumpcrete, which pumps concrete out through a pipeline. Created by a Japanese firm, it employs several new principles in pumpcrete design. Improvement in efficiency is due to the hydraulic oil pressure cushion system and the hydraulic control for the rotary valve, permitting a more rapid opening and closing of the rotary valve and also reducing the amount of stoppage due to jamming of oversize aggregate. —CE-49

Strainer Guide—An 88-page handbook of simplified selection and sizing of industrial and marine strainers has been published by Tate Engineering Inc. It contains a compilation of reference data for the layout of fluid flow systems and sizing of strainers, tabulated results of testings in its own research facilities, and valve and pipe selection information. Reference material for each strainer section is on a foldout page for easy use with any specific page in that section. —CE-50

Recommended Design Practices—By writing on company letterhead readers may receive from Metal Building Manufacturers Association a copy of the "Recommended Design Practices Manual," the result of two years of study by some of the foremost engineers in the metal building industry and other recognized authorities. One of the objectives of the association is to compile and publish recommended design standards that will insure high quality metal buildings. The section pertaining to the application of loads (including load combinations) is equally applicable to all types of construction and is not limited to metal buildings. —CE-51

Trailer Batcher—Information is available from Funderburk Mfg. Co. on the Model 300 trailer batcher, which is a plant allowing the first completely one-man aggregate handling and batching operation at a price less than one small new truck mixer, the manufacturer states. Flexible, it can be moved to any job site and two or more units operated together. It is able to be towed at highway speeds and set up in a matter of minutes. It possesses versatility, as every batch may be of a different specification of aggregates. —CE-52

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Journals: Air Transport, Construction, City Planning, Hydraulics, Sanitary Engineering, Structural.

2460. Reinforced Concrete Pavements for Airports, by August W. Compton. (AT) The use of properly distributed wire reinforcement in concrete airfield pavements controls cracking, reduces maintenance, and increases service life. As an example of the design method that is proposed, the pavement of the Indianapolis, Ind., Municipal Airport is described.

2461. Charts for Design of Reinforced Concrete Columns by W. H. Gardner, J. and Donald H. Kline. (ST) Curves are presented that enable the designer to determine immediately the necessary size and reinforcement for a given thrust and moment. The curves are based on the ultimate strength of the column section and cover six column sizes for each of three concrete strengths. The curves are directly applicable to square tied columns with eccentricities about one axis.

2462. Apron Design for Light Airplanes, by Kenneth K. Wilde. (AT) This paper presents information for the design of parking aprons for single engine and light twin-engine aircraft. Standard dimensions are suggested for laying out tie-downs, and various geometric configurations are analyzed. The operational functions of the aprons are then reviewed with respect to their needs and to each other.

2463. Aerial Photography in Arctic and Subarctic Engineering, by Robert E. Frost. (AT) The analytical airphoto procedures developed in temperate climates are qually applicable to engineering problems in cold regions. Included are: (1) consideration of the regional environmental aspects of the area, (2) detailed study of the minute characteristics and configurations composing the pattern, and (3) recognition and evaluation of the surface configurations which are the result, specifically, of permafrost and/or severe frost activity.

2464. Evaluation of Alternative Subway Routes, by B. A. Griffith and H. G. von Cube. (CP) A practical automatic computer method of assigning passenger trips to a proposed traffic facility is outlined, and the report gives the results af applying this method to proposed subway systems in metropolitan Toronto.

2465. Public Transit Improvements in Toronto, by W. F. Irvin. (CP) This article traces the significant transit developments in Toronto during the past century; describes the beginning of the latest phase, as the city turned to rapid transit with the construction of the first subway in Canada on Yonge St.; reports some of the results during the first 5 yr of that initial venture in rapid transit; and tells of plans for further rapid-transit extension during the next decade and beyond.

2466. Epoxy Asphalt Concrete for Airfield Pavements, by W. C. Simpson, H. J. Sommer, R. L. Griffin, and T. K. Miles. (AT) Studies of airfield-pavement problems which arise from the combined effects of heavy loads, fuel spillage, and jet blast have led to the development of a new type of paving material called epoxy asphalt concrete (EAC). Conventional hot-mix asphalt plants and paving equipment are used in its production. The new paving material combines the strength of portland cement concrete with the flexibility of asphaltic concrete.

2467. Airphoto Interpretation for Airfield Site Location, by James H. McLerran. (AT) The principles and procedures of airphoto interpretation are considered. To illustrate the application of airphoto interpretation to airfield site location, an area (Martinsburg, W. Va.) has been selected and an airfield-site-location analysis prepared. From a study of the airphotos three sites were selected, and a comparative analysis is presented.

2468. Design Principles for Underground Salt Cavities, by Shosei Serata and Earnest Gloyna. (SA) Theoretical equilibrium relationships substantiated by experimental studies are presented here for us in the design of salt cavities. Also included are studies on reduction of cavity volume, development of the plastic zone, strength of salt, and physico-chemical effects of waste.

2469. Tolkmitt's Backwater and Dropdown Curve Tables, by R. D. Goodrich. (HY) Tables and formulas are presented for the computation of backwater and dropdown curves for channels of parabolic section. These are followed by caution as to the selection of the coefficients C and n when used in connection with the computation of water-surface curves.

2470. Design Considerations for Fatigue in Timber Structures, by Wayne C. Lewis. (ST) Working stresses for timber are developed from average test values for clear wood by applying factors for normal variability, indeterminacy of stress analysis, natural strength-reducing characteristics present in structural timbers, and duration of loading. Normally, no allowance is made for fatigue. This paper summarizes information now available on fatigue of wood and discusses the adequacy of design based on present-day working stresses with respect to fatigue.

2471. Regional Planning in Cuyahoga County, Ohio, by Alfred A. Estrada. (SA) This paper points out the problems created in the fields of water supply and sewerage by the post-war population boom. The manner in which the problem was studied and the observations made are examined.

2472. Oxygen Balance of an Estuary, by Donald J. O'Connor. (SA) The dissolved-oxygen profile depends on the concentration of the organic material, its rate of oxidation, and the resulting rate of reaeration. The interrelationship among these geophysical and biochemical factors is described by a differential equation under a steady-state condition.

2473. Minimum Cost Design of Large Support Rings, by Kenneth P. Buchert. (ST) This paper suggests a method of design for large sup-

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INSTRUCTIONS

1. Every ASCE member can be registered in two of the Technical Divisions and receive automatically all papers sponsored by those Divisions. **Such registration will be effective 30 days after the receipt of the registration form.**

2. In addition to those papers sponsored by the Divisions in which he is registered, a member is entitled to 100 different papers during a fiscal year beginning October 1.

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4. Papers should be ordered by serial number. The member should keep a record of papers ordered to avoid unwanted duplication.

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(WW)	Waterways and Harbors

port rings. The method proposes that the outer-flange plate of the ring can be eliminated on various sections of the ring without materially affecting the ring stresses. Significant savings in the fabrication cost of the ring can, thus, be realized.

2474. Behavior of Suspensions, by A. W. Bond. (SA) There is a theory of the settling of suspensions in still water and of the behavior of suspensions in an upflow. The theory is examined with experiments on the settling of alum and lime hydroxide floc suspensions, and of their behavior in an expanding upflow. Their behavior is compared in still water and in upflow, and the application of the theory to the precipitates formed in sedimentation basins is discussed.

2475. Rationale for Determining Design Wind Velocities, by A. G. Davenport. (ST) A method is described for determining a basic design wind velocity which can be related to the expected life of the structure and from which other factors, such as the gustiness, can be determined.

2476. Sanitary Engineering Aspects of Nuclear Energy, Progress Report of the Committee on the Sanitary Engineering Aspects of Nuclear Energy of the Sanitary Engineering Division. (SA) The Committee has attempted to summarize and bring into focus a number of interrelated topics dealing with radioactivity. This paper reviews some of the advancements, current areas of interest, and future responsibilities of the sanitary engineering profession in the nuclear field.

2477. Bar-Chain Method for Analyzing Truss Deformation, by S. L. Lee and P. C. Patel. (ST) An attempt is made to extend the application of the bar-chain method in the analysis of statically determinate and indeterminate trusses. The relationships between the angles of inclination and the unit strains of the members to the actual deflection of the joints, the actual rotation of the members and the equivalent end rotations are established. The application of the method is illustrated by means of numerical examples.

2478. Hood Inlet for Closed Conduit Spillways, by Fred W. Blaisdell. (HY) The capacity and performance of the spillway for variations of the hood inlet length, the conduit slope, the wall thickness, and the approach conditions are described. The great effect of vortices on the spillway capacity is shown and anti-vortex devices are developed, and scour in the vicinity of the hood inlet is determined for various sizes of stone.

2479. Design and Cost Considerations in High Rate Sludge Digestion, by Alfred A. Estrada. (SA) This paper deals with the magnitude of data available and the effectiveness of gas versus mechanical agitation and the lack of data to fix design data for high-rate digestion tanks. Also discussed is the economic aspect.

2480. Influence of Partial Base Fixity on Frame Stability, by Theodore V. Galambos. (ST) The influence of partial base restraint on the buckling strength of rectangular rigid frames is discussed in this paper. It is shown that the rotational restraint offered by commonly used "pinned" column bases is sufficient to increase the buckling strength of these frames to almost that of identical "fixed-base" rigid frames.

2481. Waste Treatment at the Shippingport Reactor, by J. R. La Pointe, W. J. Hahn, and E. D. Harward. (SA) A comparison of the design considerations and initial performance results of the radioactive waste disposal plant at Shippingport is presented. Measuring volumes and activities of various kinds of radioactive wastes during early operation of the Shippingport Atomic Power Station are evaluated in terms of the predicted waste quantities and radioactive levels.

2482. Construction of Morrison Bridge, by R. D. Bane. (CO) Late in 1958, Multnomah County completed a new bridge in Portland, Oreg., at a cost of over $13,000,000 to cross the Willamette River and to connect through extensive approaches to downtown streets. This article reports on the construction of the 760-ft river bridge and its approach systems.

2483. Photographic Analysis for Construction Operations, by John W. Fondahl. (CO) The obstacles to the study of successful methods of construction operations are examined. An analysis technique using a movie camera to take individual exposures at timed intervals is suggested. Several applications are proposed including methods of improvement, trouble shooting, methods and equipment selection, estimating data, and effective presentation of findings.

2484. Uniform Water Conveyance Channels in Alluvial Material, by Daryl B. Simons and Maurice L. Albertson. (HY) Methods of designing uniform alluvial channels are developed and illustrated. Special emphasis is given to the modified regime theory. The results of this investigation are based on a field study of stable alluvial irrigation channels, and other existing alluvial channel data which are applicable.

2485. Resistance to Flow in Alluvial Channels, by Daryl B. Simons and E. V. Richardson. (HY) This paper presents the initial results of a flume study of alluvial channels. A detailed classification of the regimes of flow, the forms of bed roughness and the basic concepts pertaining to resistance to flow are discussed.

2486. Discussion of Proceedings Paper 1892, 2189. (AT) Temple A. Tucker on 1892. R. G. Ahlvin on 2189.

2487. Discussion of Proceedings Paper 2055, 2306, 2307. (CP) Harold M. Lewis on 2055. Edward M. Hall on 2306. Charles E. Doell on 2307.

2488. Discussion of Proceedings Paper 1956, 2142. (CO) Robert L. Schiffman on 1956. John A. Pihlainen on 2142.

2489. Discussion of Proceedings Paper 1996, 2020, 2057, 2128, 2149, 2202, 2224, 2241, 2242, 2243, 2245, 2260, 2265, 2239, 2340, 2366, 2369, 2374. (HY) L. Escande, Nicholas L. Barbarossa on 1996. Vito A. Vanoni and George N. Nomicos on 2020. William M. Sangster, Horace W. Wood, Ernest T. Smerdon, and Herbert G. Bossy on 2057. William H. Sammons, C. O. Clark on 2128. Manuel A. Benson on 2149. Robert L. Miller on 2202. E. Roy Tinney, J. W. Robertson and H. W. Bennett on 2224. A. Rylands Thomas on 2241. George N. Newhall and Frank M. Henry on 2242. Alexandre Preissmann on 2243. Robert G. Cox and Ellis B. Pickett, W. P. Simmons, Jr. on 2245. T. Blench, G. H. Lean, Lucien M. Brush, Jr., Don M. Culbertson and Paul R. Jordan, Bruce R. Colby on 2260. J. R. Philip on 2265. E. F. Trunk on 2239. T. Blench on 2340. R. G. Cox and F. L. Bauer on 2366. T. Blench on 2369. Rolland E. Kaser on 2374.

2490. Discussion of Proceedings Paper. 1777, 2090, 2250, 2252, 2343. (SA) Murray Stein on 1777. A. Pasveer, A. L. Downing, W. W. Eckenfelder, Jr. on 2090. Desso T. Mitchell on 2250. Garrett Sloan on 2252. John C. Geyer on 2343.

2491. Discussion of Proceedings Paper 1878, 2223, 2256, 2257, 2262, 2305, 2308, 2314, 2321, 2346. (ST) C. W. Yu and Eivind Hognestad on 1878. Zdenek Sobotka on 2223. Bruno Barbarito and Guiliano Augusti on 2256. A. A. Eremin on 2257. Sven H. Wichman on 2262. Kuang-Han Chu on 2305. Nabi Taskinoglu on 2308. Valeriu Petcu on 2314. Paul Rogers on 2321. Sabri Sami, Keiichiro Hayashi, Narbey Khachaturian on 2346.

2492. Planning Activity in the Cleveland Region, by Stephen A. Kaufman. (CP) The Regional Planning Commission has been working steadily, preparing Cuyahoga County's general plan. It has undertaken studies of sewerage and water supply, transportation, population land use, and regional recreation. Because of close working relationships with county and municipal officials, the Commission and staff are having some effect on current developments.

2493. Concrete Addition to Cellular Sheet Pile Shipway, by John W. Irvine and Richard F. Gaston. (CO) A graving dock used as a shipway, and constructed of cellular sheet piling in the early days of World War II, has been lengthened 100 ft. The additional length was provided by sinking a reinforced concrete trapezoidal-shaped cofferdam with the aid of open dredged wells.

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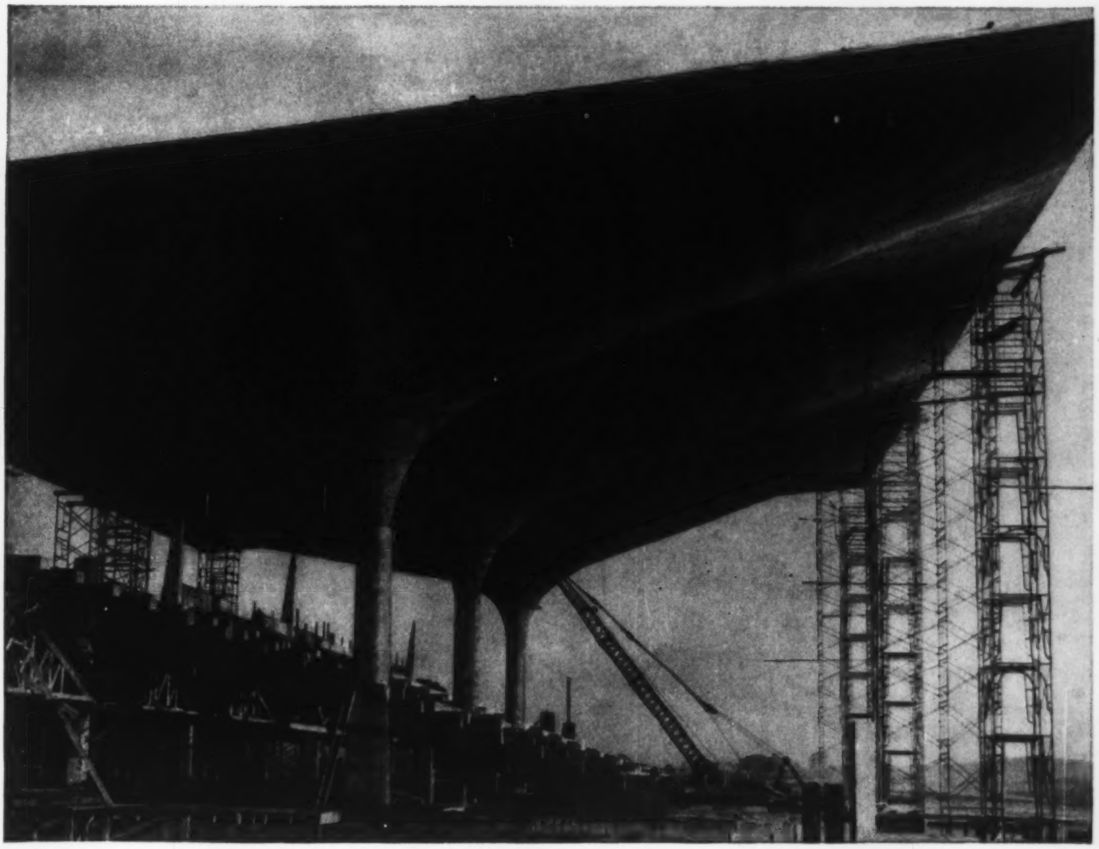

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